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Possible Biologic Hazards of STRONTIUM^{90} *and* FLUORIDATION

JAMES G. KERWIN, D.D.S., Passaic, New Jersey

DIGEST

The accumulation in the skeleton of the ions of many elements that pass from the mammalian gastrointestinal tract into the general circulation is well known. This knowledge, however, strongly indicates that a grave medical menace may be in store for us, unless preventive measures are taken before it is too late. Specifically, the increasing concentration of Strontium^{90}, due to atomic fallout, combined with fluoride, which is now being artificially added to some supplies of potable drinking water, could develop into a most serious health hazard. This article discusses the effects of radioactive elements in the human body, the process by which these elements are absorbed, and the possible additional hazards to future generations of an increase in radioactive material.

Strontium^{90} and its Effect On the Human Body

Strontium^{90} results from about 4 per cent of all fissions that occur in nuclear explosions.[1] Ordinary strontium, as well as radioactive Strontium^{90}, may be precipitated in the body in a physiologically insoluble form, as a result of chemical and biologic reactions.

Potential Health Hazard—Both strontium and fluoride ions eventually find their way into bones, and are deposited there. It has been shown that when soluble salts of strontium are consumed, the strontium rapidly accumulates in the bone tissue, from where it is then removed by normal processes but only at an extremely slow rate. These facts, especially in view of the 25-year half-life of Strontium^{90}, make this radioactive isotope a potentially serious health hazard.

Possible Irradiation Over Long Periods of Time—The beta rays emitted by Strontium^{90}, and by its "daughter element" yttrium, may irradiate bones and adjacent soft tissues over long periods of time.[2] This, therefore, constitutes a somatic danger that justifies due consideration.

Increase in Genetic Mutation—There is general agreement that any amount of radiation, no matter how small the dose, may increase the rate of genetic mutation in a population. Strontium is chemically similar to calcium, and biologically the two behave similarly.[3] This is why Strontium^{90} is taken up and concentrated in bone, where fluoride also accumulates.

Accumulation Present—According to the National Academy of Science, a measurable amount of Strontium^{90} has already accumulated in children. Presumably, most of this Strontium^{90} came from the milk of cows which had grazed in pastures contaminated by radioactive fallout from nuclear explosions.[4] The damage that may result to hemopoietic functions of bone marrow because of the radiations emanating from such internal sources, of which the body may not be able to rid itself, can be serious and even fatal.

Variations in Degree of Absorption—There are considerable variations in the degree of absorption, depending on the contents of the gastrointestinal tract, the demand for calcium, and other factors.[5]

Combination Forms Insoluble Element

Studies on the absorption of radioactive strontium by plants have shown that it is taken up as a chemical contaminant in the absorbed water. Between 1 per cent and 10 per cent of the Strontium^{90} in the soil is available to growing crops. About 5 per cent of the Strontium^{90} taken up by plants is subsequently retained by those animals which forage on such radioactive plants. Because of the affinity of strontium and fluoride to form the highly insoluble Strontium^{90} F_2, the consumption of water that has been artificially fluoridated may increase the danger of Strontium^{90} to man and animals.

Rate of Excretion Reduced—For obvious reasons, it is necessary for the body to be able to get rid of any radioactive strontium as quickly as possible. Under normal circumstances the body does this, but only at a slow rate. If, however, fluoride has been consumed, for example, from artificially fluoridated drinking water, then the Strontium^{90} and the fluoride may precipitate as the highly insoluble $Sr^{90}F_2$ within the body. This means that the rate at which the Strontium^{90} is excreted or thrown off will be even slower than ordinarily occurs.

---

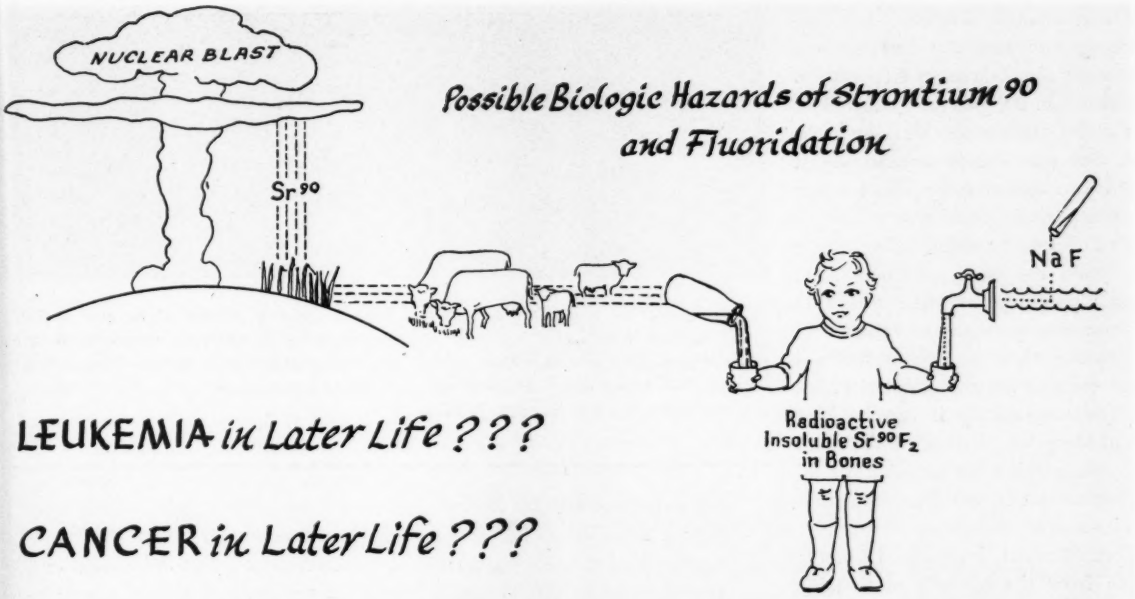
[1]Graves, Alvin C.: Congressional Hearings Special Subcommittee on Radiation, Part One, Washington, D.C. (May 27-June 3) 1957, p. 65.

[2]Mills, Mark: Congressional Hearings Special Subcommittee on Radiation, Part One, Washington, D.C. (May 27-June 3) 1957, p. 45.

[3]ibid.: p. 35.

[4]National Academy of Sciences, National Research Council, A Report to the Public 1956, p. 21.

[5]McDonald, Norman S.; Nusbaum, Ralph E.; Ezmirlian, Florita; Barber, Richard C.; Alexander, George V.; Spain, Patricia; and Rounds, Donald E.: Gastrointestinal Absorption of Ions: Part One, Agents Diminishing Absorption of Strontium, J. Pharmacol. & Exper. Therapeut. **104**:348 (March) 1952.


NUCLEAR BLAST
Possible Biologic Hazards of Strontium 90 and Fluoridation
Sr 90
NaF
LEUKEMIA in Later Life ???
CANCER in Later Life ???
Radioactive Insoluble $Sr^{90}F_2$ in Bones

Internal Radiation May be Increased—Thus, the more Strontium^{90} that is consumed, the more fluoride the body will tend to accumulate. Conversely, if more fluoride is taken in, Strontium^{90} will be retained within the bones and soft tissues longer than usual, and the body will thus be exposed to that much more internal radiation.

Fluoride Intake can be Reduced—Fallout of Strontium^{90} from those nuclear explosions that have already occurred cannot be stopped and fallout from others which unfortunately may yet take place cannot be prevented. *But the amount of fluoride consumed can be cut down.*

Factors in Consideration Of Fluoride

It is known that fluorides are powerful inhibitors of enzyme action, and that many types of enzymes are affected, including some that are essential for cellular oxidation. In this connection, it must be realized that most body processes depend upon a chain of chemical reactions, each link or individual reaction being mediated by a separate enzyme. Interference at any one point in the chain is therefore enough to disrupt the entire process. The wide variety of enzymes known to be poisoned by fluoride accounts for the different manifestations of fluorosis; that is, the different symptoms associated with fluoride poisoning.

Possibility of Gene Mutation—Life processes are so delicately balanced that any change, any departure from the normally established order at the cellular level, is likely to be for the worse. Thus a combination of radioactive strontium and fluoride, forming $Sr^{90}F_2$, could do great harm. If the entire population of the United States received small doses of additional radiation from Strontium^{90} which was combined with fluoride in the body, and was thus prevented from being excreted, it is likely that several thousands among the generation of ten million children may be definitely handicapped because of gene mutation due to the internal radiation.

Possible Higher Death Rate and Lower Birth Rate—There is still another aspect to consider; that is, a population that is exposed generation after generation to an increased amount of Strontium^{90} and fluoride may quite likely exhibit a higher death rate coupled with a lower birth rate, both due to harmful radiations and the resulting mutations.

Problems of Radiation

These fall into two classes: (a) direct effects on human beings, and (b) various ways radiation can reach human beings through the environment.

Magnitude of Biologic Hazard from Strontium-90

H. B. NEWCOMBE

There are three main hazards to peacetime populations from radiation and radioactive materials, if we exclude major catastrophes and individual accidents. These are (i) the bone tumors (and possibly leukemia as well) which can result from ingestion of Strontium-90 (ii) the shortening of life span which results from exposure of the whole body to penetrating radiation (attributable in part to malignant diseases such as leukemia, and in part to a seemingly non-specific acceleration of the aging processes), and (iii) the hereditary changes induced by radiation in the reproductive tissues.

From *Science* **126**:549 (September 20) 1957.

Environmental Factors—In considering environmental factors, food and water are of primary importance. Radiation in the general environment has so far not become a major problem. But unless care is exercised it could and undoubtedly will become more serious as time goes on.

Radioactive Contamination: In a few years the waste products from atomic power plants will constitute an enormous potential of radioactive contamination. How much of this will actually reach the population depends on how successfully it can be kept out of the great network of air, food, and water, which are the most critical environmental factors from this point of view.

Formation of Insoluble Element: Aside from the toxicity of fluoride itself, which is not to be overlooked as a specific consideration, the fluoridation of drinking water could be a dangerous threat to the public health from the point of view of Strontium^{90} because of the formation of the extremely insoluble $Sr^{90}F_2$ which can take place within the body.

Increase in Radioactive Elements—According to the National Research Council, the "natural content" of radioactive elements in food (or water) now consumed by man and animals is not the same as in the preatomic age. Though extremely small, the increase is measurable and inescapable. Fallout from atomic weapons testing has added radio-isotopes to air, soil, and water, which did not have these dangerous materials or did not have as much of them before the nuclear explosions took place.[6] The radioactive elements are taken up by growing crops through their leaves and roots, and if the levels in the air, soil, and water increase, the results might well be catastrophic. The Council of National Research states: "The material causing most concern would be Strontium^{90}". According to this authority, there appears to be no way of preventing the accumulation of Strontium^{90} in bone tissue.

[6]National Academy of Sciences, National Research Council, A Report to the Public, 1956, p. 29.

[7]Muller, H. J.: Effects of Radiation on Human Heredity, World Health Organization **2**: No. 8, 237 (August) 1957.

A radiograph of a section of the leg bone of a dog, which eight and a half years earlier had been injected with radioactive Strontium, shows both the diffuse exposure and the "hot spots" (which appear white in the illustration) where the Strontium concentrated. (From Chronical of the World Health Organization 2:260, August, 1957.)

Strontium-90 in Bone

Recent analyses of Strontium-90 in human bone in Great Britain deserve attention. A post-mortem specimen from a 1-year-old Keswick (Cumberland) child showed 2.3 Strontium units, and one from a 6-months-old Liverpool child showed 2.4 S.U. These figures are about one-quarter of the figure (10 S.U.) which the Medical Research Council recommended should arouse "immediate consideration." Since there is still some Strontium-90 in the upper atmosphere as a result of testing atomic weapons, higher figures may be expected in future even if no more tests are held.

Special Danger to Children

The figures obtained from these analyses in 1955, 1956, and part of 1957 show a wide scatter, ranging from 0.05 to 2.4 S.U., but no consistent trend is discernible. Moreover, the later figures are derived from children and infants, while many of the earlier were from adults. This presumably reflects a greater awareness of the special danger of Strontium-90 to children. Their bones take up on an average about five times more than adults, and children are more sensitive to the rays which the Strontium emits. Though these do not cause genetic damage, they may increase not only the risk of leukemia but, owing to radio-Strontium's relatively long biologic half-life of 7½ years, the risk of bone sarcomas also.

Milk Considered Main Source

Strontium-90 comes mainly from the fall-out resulting from tests of atomic weapons. The question of how it enters the body is discussed in the report, and milk is considered to be the main source. The amount of Strontium-90 inhaled in respiration is apparently exceedingly small. Rain-water contributes little except to the few people, if any, who drink considerable quantities of it raw, for the water of rivers and lakes contains at least ten times less Strontium than does rain. Though adequate data are said to be lacking, the amount of Strontium in cereals and vegetables is about the same as in milk. The importance of milk in the diet of most children probably makes it the main source of radio-Strontium for them. The radioactivity of milk rose sharply from 2 to 5 S.U. in the spring of 1955 and has since stayed fairly constant. Activity is apt to be higher in the north and west of the British Isles than in the south and east, probably owing to the higher rainfull there.

From *British Medical Journal* No. **5053**:1104 (Nov. 9) 1957.

Process of Absorption

The biologic processes involved in absorption are the following: (1) Strontium is washed onto the soil by rains and is then taken up by plants. (2) When these plants are eaten by cattle and other animals, Strontium^{90} appears in their milk and in their meat. (3) If human beings eat the contaminated plants, drink contaminated water or milk, or eat contaminated meat, the deadly Strontium^{90} is bound to enter the system. And the more fluoride consumed, the more difficult it will be to excrete the Strontium^{90} which in the meantime is emanating its radiations within the tissues.

Potential Hazard—Thus, there exists a potential hazard from the artificial fluoridation of potable drinking water: *this measure could increase the dangers associated with radioactive Strontium.*

Solution Sought—It is obvious that for the health and safety of the population, of children, and of future generations, the problems posed by radioactive fallout should include the extremely pertinent question of hazard posed by the artificial fluoridation of communal water supplies. Unequivocal evidence in this connection necessitates that the data be obtained with respect to the following problems:

(1) Reactions of Strontium and fluoride in living systems, particularly higher animals.

(2) The effect of fluoride on the excretion of Strontium.

(3) The effect of Strontium on the excretion of fluoride.

(4) Interreactions between Strontium and fluoride in water and in different soils.

(5) Mutual effects of fluoride and Strontium from the point of plant uptake and retention of these elements.

Summary

The influence of radiation on the health and welfare of human beings is a vast problem, and its importance cannot be overestimated. It would be a grave mistake to think that biologic mutations take place only in hereditary material; namely, reproductive cells. That in itself would, of course, be serious enough. But mutations can and do occur in the somatic cells of any tissue.[7] This is one way in which cancer can be experimentally induced, and another is by the use of radioactivity. Radiation acts blindly. The increasing concentration of Strontium^{90} in the body is admittedly hazardous. The possible interreaction of this isotope with fluoride to form the highly insoluble $Sr^{90}F_2$ could make the disposal of this dangerous element from the body much more difficult, thus increasing the hazard to health.

Department of Health
Passaic, New Jersey

SCIENTISTS have learned by experience that it pays to stop and think; that it is sensible to suspend one's prejudices and try to find out what the relevant facts are; that trying to decide what *is* relevant is of itself an illuminating procedure; that if the facts, as determined under sensibly controlled conditions and by competent persons, run contrary to tradition or hearsay or the position of arbitrary authority, then it is necessary to face and accept the story which is told by the facts; that logical precision in thinking is very useful when one is dealing with the more quantitative aspects of experience; that high standards of personal honesty, openmindedness, focused vision, and love of truth are a practical necessity if one is going to be successful in dealing with nature; that curiosity is a worthy and a rewarding incentive; that nature is orderly and reasonable, not capricious and mad, with the result that it is possible to attain greater and ever greater understanding of the world about us.

From Science and the Citizen by Warren Weaver, *Science* **126**: 1228 (December 13) 1957.

"The Horse's Mouth"

IT IS fair for an association to seek to advance the professional interests of its members, since this does no violence to practices generally accepted as proper to associations. But difficulties do arise when a scientific association speaks out on the social consequences of new findings. Although any association suffers the embarrassment of how to handle a minority voice, this last combination faces a special danger.

The danger lies in the possible introduction of an authoritarian note into the competition of scientific ideas. Of course, there is such a thing as informed opinion. Every informed person knows that Aristotle's physics and biology have been superseded by the physics of Newton and the biology of Darwin, which in turn have given place in various ways to newer ideas. But in the forefront of research, which is the area that bears most immediately on public issues, diversity of opinion rather than unity is what often characterizes the scientific enterprise. If there is such a thing as the party in power, then there is also the loyal opposition—loyal in its adherence to the principle that the way to settle differences of opinion is by the study of nature, and opposed in its interpretation of the present data.

From *Science* **127**:57 (January 10) 1958.

Silencing the TEMPOROMANDIBULAR CLICK:

A Method of Determining the Vertical Dimension

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DIGEST

The temporomandibular joint can click during any phase of mandibular opening, early, middle, or late. In this article all reference to the clicks which occur when the jaw is opened wide are excluded and the discussion confined to the click taking place when the condyle starts forward. The reasons for the click, the manner in which it disappears and reappears in accord with changes in the vertical dimension are described and the concept that the vertical dimension of a denture or splint can be determined by silencing the click is demonstrated.

Method to Silence Click

A persistent click can often be silenced by raising the occlusal level sufficiently. With skill an experienced dentist can place a new denture in the mouth and defy the patient to click with it. Needless to say, the click returns immediately the denture is removed, but the demonstration convinces the patient that the condition has been diagnosed at last.

Level Determined at Which Click Stops—Little difficulty is experienced in finding the critical level which stops the click: (1) the wax bite-rims are trimmed down until the click is plainly heard, and (2) layer after layer of wax is added until clicking stops. Obviously, the vertical dimension should be raised no more than necessary.

Border-line Extremely Narrow—The beginner is always astonished to find how narrow is the border-line between clicking and silence. The removal of a few millimeters of wax will often start a clicking, whereas the restoration of the same amount can quiet the joint again.

Can Vertical Dimension be Determined by a Definite Occlusal Level?—The answer to this question must be qualified: (1) It is unnecessary to state that the test depends on the presence of a click, and of course, all joints do not click. (2) The type of restoration must be taken into account.

Situations that may be Present—1. If an intraoral splint is planned and the patient is suffering facial pain, the proposed method is invaluable.

2. If the patient is free of pain, however, and merely in need of a new denture, the method is useless.

3. A third type of patient has a painless click. A splint of correct height is indicated provided the object is to cure the click, but the method has no value if it is intended to disregard the click and proceed with construction of the denture.

4. Concerning dentures, it is common experience to find that the click can be stopped only by raising the occlusion to a height which makes the denture unacceptable to the patient.

Variation in Vertical Dimension

Now that dentists are called upon to relieve pain by intraoral splinting, they encounter a new set of problems; for example, there is a dawning realization that the vertical dimension of a splint and the vertical dimension of a denture need not be identical. Ideally, the freeway space of a denture should be close to 2 millimeters. In my opinion, however, a splint should have no interocclusal clearance. This unorthodox opinion is justified in the following discussion.

Displaced Condyle Shown—Figure 1 was printed directly from a temporomandibular laminagram (tomogram). It depicts a condyle in its resting position and it is plain that it is displaced: there is too much joint space in front of the condyle and too little behind.[1] It is easy to infer that the cause of displacement is abnormal mastication.

---

[1]Campbell, John: Mandibular Displacement, Dent. Pract. **5**:175-190 (Feb.) 1955.

1. ***This laminagram shows a condyle displaced horizontally backward. The joint space is abnormally wide in front of the condyle.***

Displaced Condyle May be Shifted—If the condyle has been strained out of position and the patient is suffering facial pain, the logical treatment is to remove the cause and shift the displaced condyle closer to its physiologic position.

Difficulty Encountered—(1) How do we know that the condyle has been shifted according to plan? (2) What means is available for determining the extent of the shift? Palpation can be ruled out at once because the finger tips are not sensitive enough.

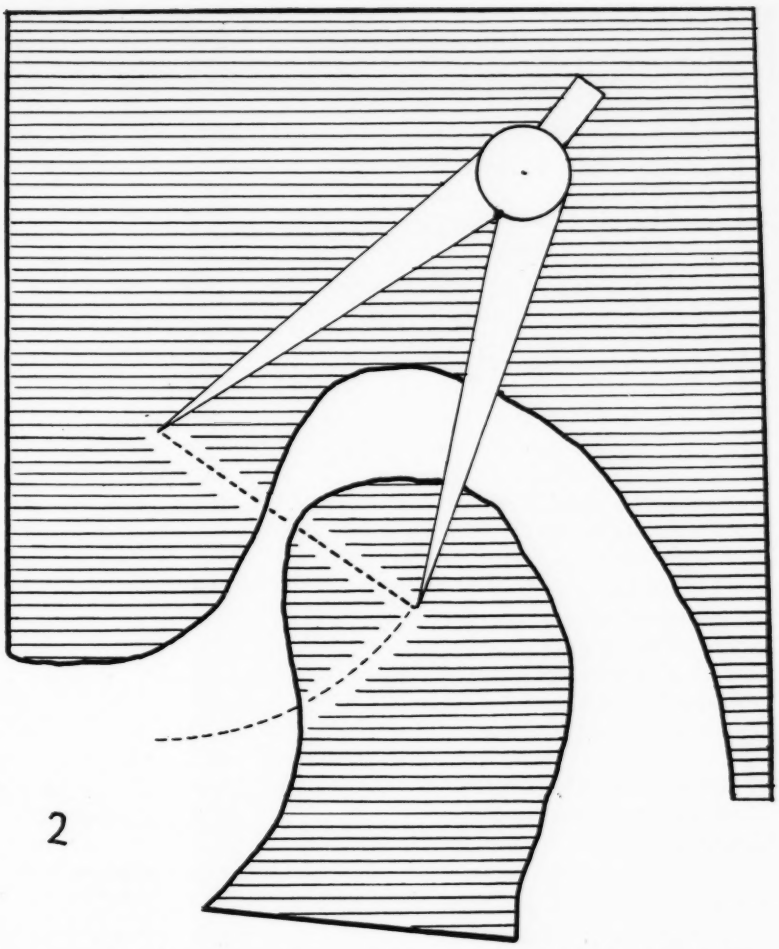
Methods for Disclosing Extent of Condylar Shift—(1) Laminagraphy, and (2) 'silencing the click,' may be employed for disclosing the extent of condylar shift.

Proposed Solution of Problem

Level of Occlusion Built up—Using laminagraphy, the level of occlusion would be built up in successive stages, recording the joint by laminagraphy after each addition. Sooner or later, a laminagram will be produced showing the beginnings of condylar shift. Personally, this procedure is not favored although we have experimented with it for years. It is useful for research, but for practical purposes it is overelaborate and conducive to roentgen overdosage.

Click a Manifestation of Disorder—The alternative method for ensuring that the displaced condyle has shifted, is to silence the click as described. It could reasonably be claimed that a click is a manifestation of disorder, and if it can be silenced, then raising the occlusion has conferred benefit. X-ray examination shows the improvement effected. Raising the occlusion moves the condyle closer to the articular eminence.

Freeway Space Eliminated—Radiographic investigation will also confirm another point of fundamental importance: a displaced condyle will not shift its resting position so long as a freeway space exists. If the occlusal level is raised, leaving the conventional 2 millimeters of interocclusal clearance, the displaced condyle remains undisturbed. Making practical use of this theorem, the freeway space is eliminated. It should be eliminated to the vanishing point. In short, if the resting position of a condyle displaced backward is to be improved, the occlusion must be jacked up.



2. ***A diagrammatic representation of the inclination of the temporomandibular ligament while the jaw is closed. The curved line depicts the swing of the ligament when the condyle descends. This mechanism holds the condyle, together with its meniscus, in firm sliding contact with the eminence.***

Minimum Raise of Vertical Dimension—Indiscriminate jacking-up invites trouble. The vertical dimension should be raised only the bare minimum to satisfy requirements. A bite-raising splint should not be worn longer than 8 hours at a time, at least at the beginning of treatment. Later, as the muscles and joints adapt themselves to the new situation, the splints may be worn for longer periods.

Splints Preferred to Relieve Pain—Another reason for preferring splints to dentures for relieving pain is that it would never occur to a patient to wear the splints outside the privacy of the home. Therefore, they do not constitute a social handicap, so that the appearance of the patient need not be considered.

Measures for Patient Comfort

Bearing in mind the tenderness of edentulous ridges and the need to raise the occlusion as gently as possible, patients are supplied with resilient splints made of poly-vinyl chloride. They are easier on tender ridges than hard acrylic dentures.

Early Relief Obtained—In successful cases, the facial pain is relieved within a few weeks. In a later stage the click does not return when the splints are removed. This does not

mean that the click is permanently cured; on the contrary, the click is likely to return if the splints are abandoned.

Splints Removed for Testing—During a periodic visit, the splints may be removed to test for clicks and it may be found that they have disappeared, at least for the time being. The so-called permanent restoration may be undertaken at this time.

Method not Always Successful—It must not be taken for granted that every temporomandibular click can be silenced in this manner. On the contrary, the bite-rims have frequently been raised to extravagant heights without correcting the click at all.

Usefulness of Technique Extensive—At first glance, it might seem that the method here described has restricted usefulness, but the converse is true. There is a surprisingly large number of people, especially elderly people, who suffer facial pain and temporomandibular click.

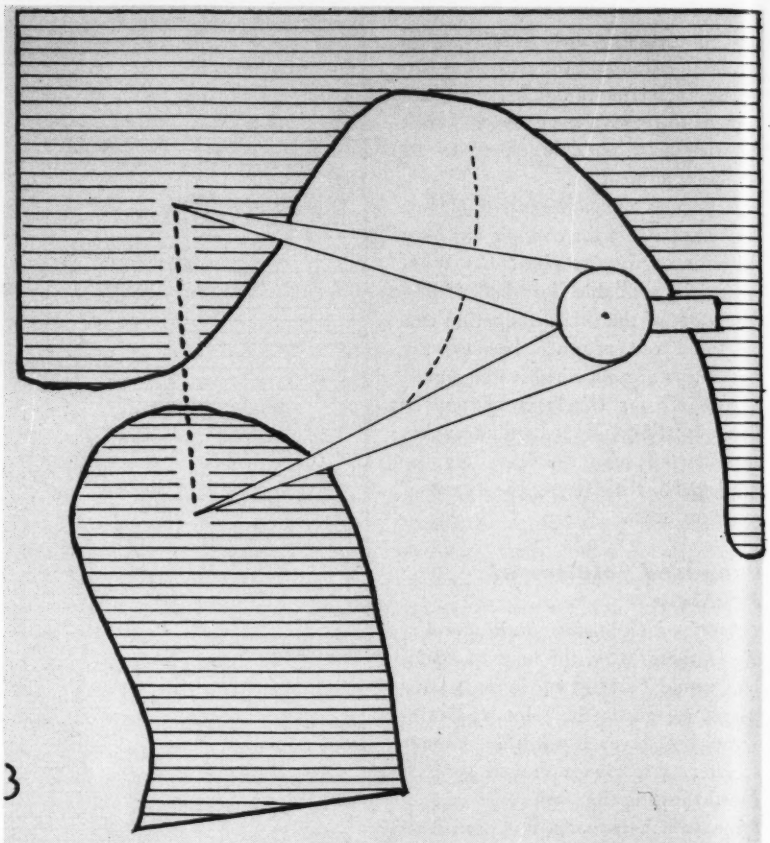
Movement of the Condyle And Related Cartilage (Meniscus)

The feature which controls the smoothness of the condyle's action is the obliquity of the temporomandibular ligament at rest.[1,2,3] Figure 2 shows how the fibres run; it will be seen that they are almost taut; in fact they become taut with the slightest backward movement of the condyle.

Normal Descent of Condyle—Figure 3 shows the normal descent of the condyle when the jaw opens. Despite the fact that the fibres of the ligament have swung to a vertical inclination, they have not stretched.

Overclosure of Mandible—Imagine that the mandible has lost teeth and that it begins to overclose persistently. With repeated overclosure, the condyle will move from the position shown in Figure 2 to that shown in Figure 1.

Identical Fibres—The fibres which hold the cartilage down onto the condyle, are identical with those which hold the condyle against the articular eminence; if one part is stretched, so is the other. This explains the mechanism which loosens the cartilage from its seat on the condylar head, and explains why it can now move independently (Fig. 4).



3. ***Shows the condyle at the nadir of its physiologic descent. The temporomandibular ligament has not stretched.***

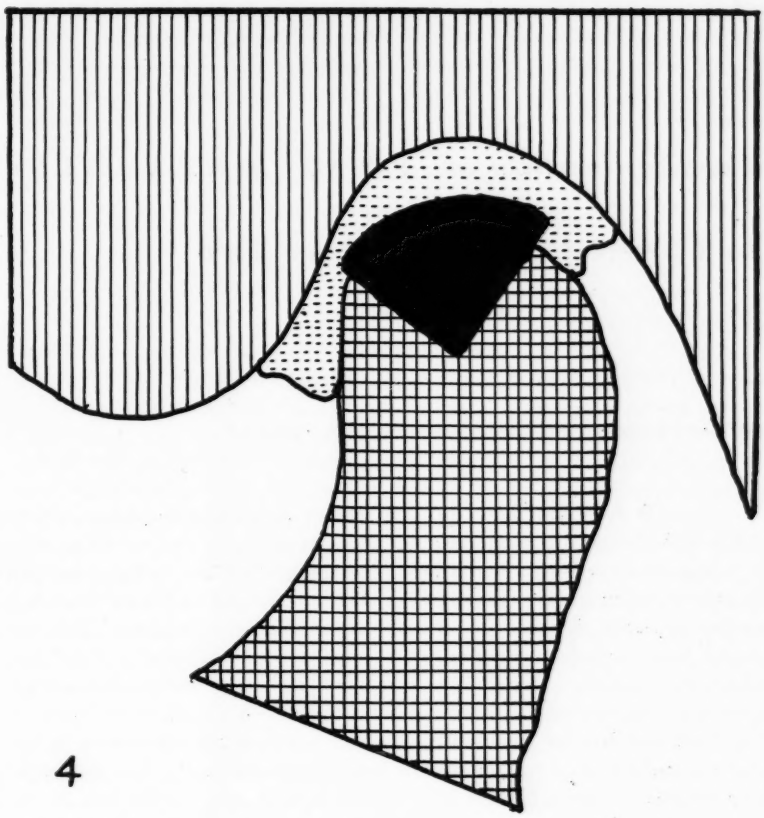
Detail of Condylar Closure

In physiologic function, it appears that condyle and cartilage travel in unison. Ideally, the closing movement should be arrested by the teeth, so that condyle and cartilage stop simultaneously. In overclosure, however, the cartilage could stop before the condyle, the latter continuing on its backward passage: it might actually climb out of the hollow of the cartilage and rest momentarily on its thick rim (Fig. 5).

Overclosure Essential Element—The jaw now opens and the movement goes into reverse. The condyle starts forward and drops off the thick rim into the hollow of the cartilage, making the characteristic click. It will be seen that overclosure is an essential element in the sequence. Overclosure sets the scene for clicking by poising the condyle on the thick posterior rim, ready to bump into the hollow. If abnormal muscle tension snaps the condyle into place, the click may be loud. It will be louder still if the depth of the hollow has been eroded so that the bone of the condyle strikes the bare bone of the fossa.

Result of Backward Movement—In a more advanced stage of temporomandibular deterioration, the condyle can pass back still further, 'leapfrogging' as it were, over the posterior thick rim. On reaching that position it will compress the meniscus into the anterior zone of the glenoid fossa, wedging itself against the tympanic plate. Figure 1 shows how the posterior surface of the condyle conforms to the tympanic plate. This ex-

[2]Rees, L. A.: The Structure and Function of the Mandibular Joint, British D. J. 96, No. **6**: 123-133 (Mar.) 1954.
[3]Hjortsjo. C. H.: Studies on the Mechanics of the Temporomandibular Joint. Lunds Universitets Arsskrift, N.F. Avd. 2. Bd. 51. Nr. 2.



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4. ***Represents the cartilage diagrammatically and shows how it is held down on to the condyle. The fibres of the capsular ligament are attached at the poles of the condylar head (the apex of the dark area). The condyle can therefore roll on the smooth underside of the cartilage. By this arrangement, the cartilage accompanies the condyle in its wider excursions.***

plains why the jaw is now difficult to open. In this type of lock, the incisors are fairly close together. Fortunately, the condition is transitory in most instances.

Comment

Conventional Level Must be Maintained—Reverting to the technique of silencing the click, it is emphasized that while the bite-raising splints may be discarded at the appropriate time, they must be followed up with restorations of conventional occlusal level, and this level must be maintained.

Patient Education Important—The patient should be informed that the process which mends the cartilage to the condyle is slow and should not be disturbed. Therefore, to prevent the cartilage breaking away from the condyle while the repair is incomplete, the patient must not click the jaw. Every click represent another dislodgement of the cartilage. The patient must understand that one single act of overclosure will break a partly organized fibrous union. If the jaw clicks as much as once, the whole process of repair must be undertaken from the beginning.

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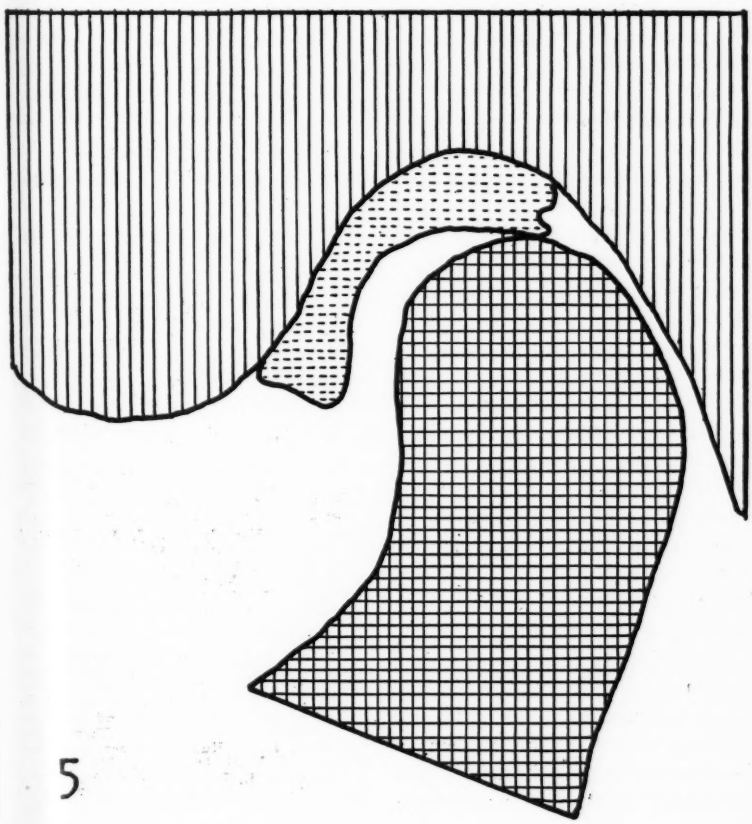

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5. ***In cases where the temporomandibular ligament has been stretched or torn, the condyle will part from the cartilage. If the condyle moves too far back it may climb out of the hollow of the cartilage and poise on the thick rim ready to click back into position. It should be realized that this is a diagram and not a dissection: the posterior edge of the cartilage does not end abruptly, it merges with soft fibrous tissues which can stretch during the descent of the condyle.***

Fundamentals of FOOD METABOLISM *in Clinical Practice: Part Two*

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DIGEST

This is the second installment of a two-part article on nutrition. In this installment the author discusses in particular the five classes of food required by man to maintain health. Some of the common superstitions concerning food and diet are exposed and the clinical effects of refined carbohydrates in the diet are demonstrated. The distinction between intake and assimilation is made and the endocrine function which controls body metabolism and the relation between this function and disease is clarified. In conclusion the author suggests the basic components of the ideal diet.

Types of Food

A balanced diet must contain all five classes of foods: proteins, fats, carbohydrates, vitamins, and minerals. Most foods in their natural state contain all of these factors but never just one.

Combination of Elements—Generally, one of these elements may predominate, but smaller quantities of the others will also be present. The same requirement holds true for the digestion of the various foods. In the digestion of carbohydrates, for example, (1) a molecule of protein must be present, (2) a phosphate radical, (3) several of the vitamin B complex, and (4) the metabolites.

Minerals Necessary—The essential minerals must also be present for the enzyme action to take place. Tuttle[53] calls attention to the *prevailing misconception* that the average American diet supplies all necessary food factors in adequate amounts: "This is a belief not substantiated by fact." Jolliffe[54] makes the same observation.

Protein—While all of the types of food are of equal importance in human metabolism, the fact that protein is most often insufficient in the diet gives it greater prominence. There is hardly an activity of human metabolism that does not require protein for normal function, but tissue repair is its principal activity.

Aid to Resistance to Infection: Authorities now recognize protein as the dietetic agent of choice in promoting resistance to infection,[55] in rheumatic fever, tuberculosis,[56] heart disease, and in geriatrics,[57] obesity,[58] hypoglycemia,[59] ulcers, anemia, arthritis, epilepsy, hypertension,[60] acne, caries, and many other morbid states. It is no accident that a purine-free diet has failed in gouty arthritis. If protein is essential for sound nutrition, depriving a patient of this important element can only serve to intensify disease as well as fail to secure a remission. A lack of protein in the diet during illness, frequently introduces complicating factors because of hypoproteinemia.

Vegetarianism Impractical: Since the only complete protein in the vegetable kingdom is the soy bean, dependency upon animal protein as the principal source of supply is unavoidable.[61, 62] Vegetable proteins are biologically inferior.[63] It is precisely for these reasons that indulging in the food fad of vegetarianism is ill-advised.

Fat—The role of fat in human metabolism is probably the most commonly misunderstood of any element of diet. Fat is valuable as an essential element of the diet principally for its content of fatty acids and fat soluble vitamins. In addition to its caloric function of providing fuel for heat and energy, fat is also needed for lactation, well-being of dermal tissue and growth.[64]

Sources of Fat—Valuable sources of fat aside from that of meat are (1) fish oils, (2) vegetable oils (soybean, cottonseed, olive, peanut, corn), (3) eggs, (4) nuts, and (5) butter.

Weight Loss Encouraged — The false notion should be dispelled that eating fat encourages obesity. Actually, only a little fat may be metabol-

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[61]Flodin, N. W.: Amino Acids and Proteins, Their Place in Human Nutrition Problems. Agricultural and Food Chemistry **1**:223 (April 29) 1953.

[62]Allison, J. B.: Amino Acid Requirements of Man, Borden's Review of Nutrition Research (September-October) 1955.

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[64]Deuel, H. J., Jr.: Non-Caloric Functions of Fat in the Diet, J. Am. Dietet. A. **26**:255-258 (April) 1950.

ized into glycogen[65,66] which may be stored as depot fat if body requirements for this material have been met. Patients are permitted fat according to their desire for it. Not only does fat *not* increase weight, but weight loss continues during its use. In discussing a reducing diet, Pennington states that "A ketogenic diet consisting essentially of protein and fat appears capable of enabling the organism to utilize large quantities of fat."[58]

Life Sustained on Diet Rich in Fat—Stefansson, the polar explorer, lived for about five years on a diet of fat meat exclusively, and on the same diet for one year in New York under the supervision of scientists at Bellevue Hospital. He was found to be in better health at the end of the year than at the beginning.[67] The cause for obesity is obviously not fat in the diet. Other causes for increases in body mass will be discussed later.

Fat in Relation to Atherosclerosis—A great deal has been written about fats and their role in atherosclerosis. Many still labor under the false assumption that eating animal fats will result in an increased serum cholesterol and eventual arteriosclerosis. This has not been our clinical experience. Patients with an initially elevated cholesterol who have been permitted fats *ad libitum*, have actually shown a drop to normal cholesterol levels *after the apparatus of assimilation has been restored to normal function.*

Cholesterol Synthesized by Liver—Many others have demonstrated that the cholesterol level in the blood is independent of intake.[68,69] It has been observed that hypercholesterolemia may be due to impaired liver function.[70] Keys also notes that the liver may synthesize cholesterol even if none is ingested.[71] Moses observes that "Large amounts of cholesterol, as much as 20 times that absorbed from the diet, are synthesized daily from radicals as small as acetate."[72]

Hydrogenated Fat and Heart Disease—A grave threat to health and an added obstacle in obtaining the essential unsaturated fatty acids is the current practice of hydrogenating vegetable oils. Jolliffe[73] attributes the high incidence of coronary heart disease to the increased use of *saturated fatty acids* (margarine, hydrogenated vegetable cooking fats, hydrogenated peanut butter). In his opinion the unsaturated fatty acids (oils) actually help to clear the blood stream of excess cholesterol. Another aspect of the cholesterol problem will be discussed under assimilation.

Animal and Vegetable Fats Useful in Diet—"Overheated or burned fat is known to have a weak carcinogenic activity."[74] How often this occurs in the preparation of potato chips or other fried foods is worthy of conjecture. It appears that both animal and vegetable fats should be sought, but they should be eaten in combination with other foods. It does not matter whether oils or solid fats are ingested, as long as they have not been altered from their natural state.

Carbohydrates—Undoubtedly the greatest destructive force to good nutrition, and the cause of the alarming increase in degenerative disease, is the dramatic increase in the use of *refined* carbohydrates. The immediate result of the augmented use of refined, white flour products, refined cereals, and sugar is a chronic deficiency of vitamins B and E. Caries, chronic fatigue, and sterility are much more common today than ever before. While the body can convert 58 per cent of protein to eventual fat, and about 10 per cent of fat to the same end, it converts 100 per cent of carbohydrates (refined) to fat.

Carbohydrate Converts to Fat—It is well known that livestock are fattened for the market with corn which has a high carbohydrate content. Carbohydrate makes fat; protein makes muscle. Nowhere in the world is there as great an obesity problem as in the United States.

Effects of Carbohydrate Intake in Disease States—(1) Diabetic patients permitted *refined* carbohydrates developed the usual complications of diabetes. On a diet which restricted these items, the patient was able to reduce markedly his intake of insulin. Ignorance of the difference in action upon the endocrine glands of *refined* carbohydrates compared to that of unrefined carbohydrates, caused the insulin demand to increase notably while the patient continued to develop the complications of diabetes.

(2) Intelligent arthritic patients taught us to reduce to a minimum all grains to lessen or eliminate pain. Refined carbohydrates always intensify arthritic pain. It is also an error to prescribe a high carbohydrate (generally refined) diet in nephritis. The inevitable result is the appearance of the complications associated with this condition.

Sugar in Diet—No nation in the world consumes as much sugar as the United States. Certainly sugar, devoid of any nutritive value, containing only the calories of pure carbohydrates, is not only *not* among the recommended foods,[75] but renders incalculable harm. Almost every food produced commercially has sugar added. Use of such foods perverts the sense of taste so that it cannot be relied upon to select foods unless they are sweet.

Hypoglycemia Increased by Sugar—The use of sugar or other refined carbohydrates in hypoglycemia can only perpetuate and aggravate this disorder which is both nutritional and endocrine. This is so because sucrose has a different rate of absorption and a different effect upon the blood sugar than does fructose (fruit sugar).

Violent Reaction from Sucrose—Several different kinds of glucose exist, and while they may appear to

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[71]Keys, A.; Anderson. J. T.; Mickelsen, O.; Adelson, S. F.; and Fidanza, F.: Relation of Diet to Serum Cholesterol, Mod. M. **24**:75 (September 1) 1956.

[72]Moses, C.: Prevention and Treatment of Atherosclerosis, JAMA **165**:492 (October 2) 1954.

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[75]Wilder, R. M., and Keys, T. E.: Handbook of Nutrition, JAMA **120**:531 (October 17) 1942.

be similar chemically, each may produce a different action *in vivo*. The most violent reaction always comes from sucrose: not fructose (See Figure 2, Part One). In dietary experiments with glucose and the regular diet, in several different physical types, glucose (in glucose tolerance tests) always produced a much higher postprandial rise in blood sugar as well as a more precipitous drop than the regular meal. [76,77]

Pure Carbohydrates Should Never Be Consumed—It is wiser to forego carbohydrates than to risk their harmful effects. In nature, high carbohydrate foods are always combined with other elements. The consumption of carbohydrate foods should be confined to vegetables, whole grains, fruits, and nuts in their natural form.

Vitamins—Vitamins are plant hormones and therefore exogenous to man. They function as catalysts in enzymatic reactions with other necessary food elements. All of the vitamins present in foods are not completely known, nor is their action entirely understood at the present time. Nevertheless, it is important to investigate the different kinds of vitamin actions, as well as the signs of vitamin deficiencies in their various degrees of manifestation because of the prevalence of these deficiencies.

Various Uses of Vitamins—Vitamins may be used to maintain health, or as drugs. Their form is different and their dosage is different for each purpose. If used for dietary supplementation to compensate for food deficiencies, vitamins should be in the form of *food concentrates*. These contain all of the natural food elements accompanying the vitamins with only the water and some fibre removed. They must be completely organic[78] without any inorganic minerals or crystalline vitamins included. This type of vitamin is not quick acting and may take weeks or months to show its effects. Dosage depends upon (1) the degree of physical degeneration encountered, (2) the physical type of the subject and his endocrine pattern, (3) the diet and symptomatology, which includes the type of avitaminosis.

Vitamins as Drugs—The inorganic, crystalline, or synthetic vitamin has a special use in diet. Crystalline vitamins are always used for their pharmacodynamic effect, in high potency —as drugs. Their action is rapid compared to the organic (natural) vitamin, and they are extremely useful for the *acute situation*. Their action is specific but not without side effects. It is precisely this characteristic that often produces the toxicity of which these vitamins are capable. It must be remembered that synthetic vitamins are fractions of vitamin complexes.

Possible Toxic Reactions—Toxic reactions with organic vitamins do not occur even if used in higher than usual dosage for some acute condition. Inorganic, crystalline, or synthetic vitamins occupy a definite and useful place in the armamentarium of vitamin therapy but their use must be attended with consideration for their limitations and possible toxic reactions.[79]

Minerals—The role of trace minerals in human nutrition has gained a wider appreciation. Trace minerals are believed to be the precursors of enzymes, and as such, their function in enzymatic reactions has assumed greater importance. It is known that iodine is necessary for the thyroid, zinc for the pancreas, iron, copper and cobalt for blood building. It has also been learned that "At least one nonreplaceable function in an enzyme system has been identified for every trace element except boron and manganese,"[80,81] thereby emphasizing their importance in metabolic processes. If a trace element is absent, the specific enzyme reaction which depends upon it cannot take place. If the digestion of a protein is involved, it is conceivable that in an incomplete enzyme reaction, the undigested protein may act as a foreign protein in the body and create an allergic reaction.

Condition Improved by Trace Element Therapy—Metabolism has been improved and recovery from pathologic conditions has been aided by trace element therapy. Physiologists and biochemists state that the heart muscle is fed by ions of calcium, sodium, and potassium. These apparently come to the heart via foods, in a balanced combination. If in cardiac disease a salt-free diet is prescribed and the patient does not improve but deteriorates, such therapy must be in error. While attention is given to electrolyte balance in an effort to reduce edema by the administration of potassium, the difficulty may be in the metabolism, perhaps of carbohydrate, in which case vitamin therapy would be indicated and not necessarily mineral therapy. While the three minerals mentioned may not be in the trace element category, they may be cited to illustrate the acceptance of minerals in metabolic therapy.

Brucella Successfully Treated—The trace minerals of manganese, copper, cobalt, magnesium, and zinc were used in combination to treat successfully 1800 cases of brucella infection.[82] This places brucella infection in the category of deficiency disease, the specific bacterial proliferation being due to a change in the internal environment which provided the proper medium for that particular bacterial life.[83,84,85]

Health Achieved by Proper Food—While inorganic trace minerals are satisfactory for the treatment of acute conditions where they are employed as drugs, and as a temporary measure, the intake of trace minerals to maintain health is best accomplished in the form of food. If they are taken as food supplements, they should be in the form of an organic plant because nature has balanced the constituents in a manner that is still be-

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yond comprehension. No single food used by man is inorganic. Clinical experience has shown that trace minerals, taken in an organic form, have been beneficial in many chronic morbid states, particularly as applied to tisssues of ectodermal origin. Inorganic minerals may be toxic.

Assimilation

An adequate intake does not assure its assimilation unless the apparatus of assimilation is functioning normally. It is a mistake to assume that food taken into the body automatically arrives at each and every cell at the right time, in proper form and quantity, ready for use, and that it is immediately utilized.

Endocrine Function

The *assimilatory apparatus*, or body metabolism, is *governed by endocrine gland function* through the autonomic nervous system. The autonomic nervous system consists of the sympathetic (governing the speed-up glands) and the parasympathetic (governing the slow-up glands) systems. These two groups of endocrine glands are antagonistic to each other in their action. (See Figure 3, Part One). When their interaction is balanced, the body functions perfectly[86] and there is no disease.

Catabolic and Anabolic Characteristics—A characteristic of these glands is that the sympathetic group is catabolic, while the parasympathetic is anabolic. Their reaction therefore toward the same food or other element of the environment will differ according to which group of glands is dominant in each person. The anabolic dominant person is slow moving, puts on weight easily with little food, is deliberate in his thinking and conservative of his energy. The catabolic person is quick of action, is usually thin no matter how much he eats, is easily excited, thinks quickly, and uses up energy at a rapid rate (catabolic fashion). The dominance of sympathetic or parasympathetic glands will determine the diseases to which the subject will be susceptible (See Figure Four, Part One).

Faulty Metabolism as Causative Factor—It has been stated that the metabolism of food must be considered from the aspects: (1) intake, and (2) assimilation. Applying this reasoning to the problem of hypercholesterolemia, it is seen that the fault is one of disordered endocrine function. It is precisely because the cholesterol problem is a fault of metabolism, not of intake, that *cholesterol levels fall to normal when the endocrine system is restored to normal function, despite the fact that the patient is ingesting high cholesterol foods*. That faulty metabolism is likewise the causative factor in anemia, arthritis, diabetes, and ulcers, has been revealed clinically.

The Endocrine Pattern

The sympathetic or the parasympathetic side of the endocrine system may be dominant in a person. Parts of, all of, either side, or both sides of the endocrine system may be overactive, underactive, or functioning normally. This is the *endocrine pattern* of the person. The endocrine pattern is acquired by heredity. The thin, wiry, nervous person who is a duplicate of a parent or grandparent is frequently seen.

Reaction to Environmental Influences and Food—Since the subject's endocrine pattern determines his reaction to environmental influences and food, this fact must be considered in determining the part of the metabolism which is at fault. As an example, the hypothyroid cannot convert carotene to vitamin A; the hyperthyroid has a greater requirement of vitamin B as well as a different glucose tolerance. Perhaps it is because of the differences in each person's reaction to his environment that it is virtually impossible to conduct a controlled scientific experiment with human beings, except to draw general conclusions.

Effects of Food on Endocrine Glands—Although the endocrine pattern is inherited, environmental influences such as food may either maintain it as inherited, or cause it to degenerate. Well-alined dental arches, free of caries, found among the Eskimos or other primitive peoples existed until they began to subsist upon the white man's refined white flour and sugar. Caries and malocclusion (an endocrine aberration) then appeared. What happened to the inherited endocrine pattern?

Function of the Posterior Pituitary—One of the known effects of refined foods upon the endocrine system is that produced by refined carbohydrates upon the posterior pituitary. A function of this gland is the regulation of carbohydrate metabolism. Continued insult of this gland causes it to function abnormally. Since the posterior pituitary also controls water balance in the body, gonadal function, parturition, and muscle tone, in addition to its contributory interaction with other endocrines such as the adrenal cortex and pancreas, its functional effects can be *far reaching*.

Results of Malfunction: It is not surprising, then, that malfunction of the posterior pituitary can be responsible for menstrual dysfunction, spontaneous abortions, failure in lactation, congestive and myocardial heart failure, gastrointestinal ulcers with attendant anemia, renal malfunction, edema, diabetes, hypertension, hypogonadism, migraine headaches, epilepsy, and obesity.[86] These conditions have been eliminated by the administration of minute amounts of this hormone to correct body chemistry.[87]

Edema from Posterior Pituitary Malfunction: Obesity may be of two kinds; one is true adipose tissue while the other is edema. In edema, the tissues are water logged and usually stigmatize the subject with what is known as the abdominal apron, a large fold of loose, abdominal dermal and subcutaneous tissue which often hangs down to below the genitalia. It is obvious that caloric restriction alone can only result in failure to achieve results in this type of obesity. Another manifestation of posterior pituitary malfunction is that observed in hypoglycemia. This condition was discussed with carbohydrates.

Effect of Refined Carbohydrates on the Pancreas—Intake of *refined* carbohydrates triggers a surge of insulin into the blood stream to lower quickly the excessively high blood sugar. Carbohydrates in the form of vegetables, fruit, or whole grains, require diges-

tion in several stages and with the restraining action of the protein and/or fat present, enter the blood stream slowly. There is no real postprandial rise in blood sugar after the ingestion of protein. Refined white flour and sugar do not have these accompanying processes, and after one or two stages of digestion enter the blood stream in a flood. This action occurring many times daily has a permanent effect upon the pancreas,[88] often resulting in hyperinsulinism.[89]

Effect of Vitamins in Function of Endocrine Glands—Vitamins, being closely related to hormones, play an important part in the health and functional integrity of all the endocrine glands: (1) Vitamin A and its control of iodine availability for the thyroid has been mentioned. (2) Vitamin B is important because of its increased demand in hyperthyroid patients, and its indirect effect upon the gonads in its role of estrogen inactivation in the liver.[90] (3) Vitamin C is important to the adrenals. (4) Vitamin D is well known for its effect upon the parathyroids. (5) Although best known for its effect upon the gonads, vitamin E has many other functions. The knowledge of the complete role of all the vitamins, known and unknown, upon the endocrines, still has many gaps to be filled.

Possible Effects of Milk on Endocrine System—The inclusion of milk in the diet of the child beyond weaning, or in the diet of the adult, may be fraught with danger because of its hormone content,[91] its possible allergic effects, its frequent displacement of more essential foods from the diet, as a factor in the production of periodontoclasia and osteoporosis,[92] as well as its possible agency in the production of disease or transmitting it. Overstimulation of the anterior pituitary by the growth hormone of milk,[50] the production of hypogonadism by the androgens and estrogens contained in milk are distinct possibilities.

Dietary Conclusions

It has been shown that to establish a diet that satisfies all the requirements for proper nutrition, the intake must include an adequate quantity of food governed by a normal, unperverted appetite. Food of good quality can only come from a rich soil unpolluted by chemical sprays. To maintain high quality, food must be fresh, unfractionated, unadulterated, and properly prepared to preserve food values. In a balanced diet all types of food elements must be present including protein, fats, carbohydrates (as unrefined grains, vegetables, fruits), vitamins and minerals. Foods individually, as well as the diet in general, must contain all of these for normal metabolism. In order to metabolize a carbohydrate, fat, or protein, all three must be present, together with vitamins and minerals.

Deficiencies in Refined Carbohydrates—It is important to remember that refined carbohydrates are either markedly deficient or entirely devoid of vitamins, minerals, and other essential elements of the diet. Their inclusion in the diet will cancel the good of essential foods and will *increase* the *quantity* of food required for adequate nutrition. In addition to harming the body generally, their effect upon the endocrines is destructive.[93, 95]

Items to be Excluded from the Diet—Specifically to be excluded from the normal diet are refined, white flour products, refined cereal, sugar, and milk.

High Protein Diet Preferred—What then can we eat? It has been stated that in a high protein diet after the essentials anything else desired may be eaten. This is the prime error. The high protein diet only, *without* the harmful refined carbohydrates is acceptable. This has been found clinically to be a normalizing diet which produces excellent results. It is the diet recommended for nearly every pathologic condition by informed clinicians.

The Ideal Diet—The diet used successfully in the practice of dental medicine includes only the following, without restriction of quantity except that exercised by a normal, unperverted appetite:

1. 100 per cent whole wheat bread (no white flour content), or 100 per cent rye.
2. 100 per cent whole grain cereals (unrefined, with no additives).
3. Meat, seafood, poultry, eggs, butter, heavy cream (in coffee and/or cereal).
4. Vegetables, berries, fruits, seeds, and nuts.
5. For snacks, 100 per cent whole grain crackers (wheat or rye) and unhydrogenated peanut butter, fruits and/or nuts are used. Coffee and tea are permitted in moderation.

Cause of Failure of Nutritional Therapy—The failure of nutritional therapy as usually employed, to effect recovery from various types of disease, is attributed to a lack of familiarity with the technique of its administration in nutritional therapy and insufficient knowledge of the subject.

Summary

Dietetic standards for sound nutrition have been established. The elements of a proper intake have been presented. The effects upon the human metabolism of an unbalanced intake, inadequate intake, and poor quality intake, have been demonstrated. The role of the endocrines in the assimilation of food as well as the effects of foods upon it, has been discussed. The foods permitted in a diet containing all the elements for sound nutrition with the exclusion of the harmful foods have been enumerated.

Gay Street at Church

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Some Confusing Concepts in ARTICULATION: Part One

HARRY L. PAGE, Valparaiso, Indiana

Specious reasoning in articulation, as in any subject, is insidious. Being plausible, it fosters confusion and retards progress. A prominent name alone is frequently accepted as sufficient authority for seemingly authentic statements that are, actually, careless opinions.

The purpose of this two-part article is to encourage analysis and open criticism. It suggests consideration of the historic fact that scientific advances are never made except by disproving existing concepts or by rendering them obsolete; and recognition that advancement in articulation knowledge is overdue.

Changes in Modern Articulation Theory

Recent developments in articulation concepts have necessitated numerous changes in theories, which involve aspects of mathematics and physics well understood in ordinary science but apparently unfamiliar to articulation leaders. Most authorities in conventional articulation have shown little disposition to consider these theories. On occasions where they have done so, their approach has been perfunctory and unmistakably antagonistic.

Criticism Expressed—The terminology of the new principles has been criticized as being too "complicated," and it has been suggested that both the subjects and their terminology should be reduced to such a level that even the "unthinking reader" could absorb them with little or no mental effort. Otherwise, it is claimed, publication has been of no value for the average dentist will not bother to read difficult material.

Deviation in Pedagogy—This attitude requires that the beginner shall dictate what subjects are to be studied and shall determine how they shall be presented. It infers that if the neophyte cannot understand them, they are not worth presenting. The possibility that the subjects introduced could be helpful in solving the neophyte's troublesome problems, and that the terminology is standard for these subjects is not apprehended.

New Ideas of Value—Present concepts are hardly so successful that their proponents can afford to be arbitrary. It would seem appropriate that *any* new idea should be welcomed and studied eagerly rather than be resented and avoided.

Leader Responsibility

It is not to be expected that the rank and file will undertake to absorb or even read unfamiliar theories upon initial presentation. They are not interested and are too busy. Logically, the task of absorbing new concepts is left to teachers and leaders. Elevation of general clinical knowledge and ability then develops naturally by infiltration as educators incorporate new philosophies into teaching and clinical practice. Hence, to accord no value to a new idea because it may not appeal immediately to the rank and file is thinking in reverse.

Limitation of Knowledge Disappointing—That the subjects involved in these principles should be unknown to teachers of dentistry is frankly disappointing. Articulation deals with motion in three dimensions; it has always done so. To find that teachers in what is officially more than a century-old profession and one of whose major problems requires complete understanding of tridimensional movements, do not even know the names of the three dimensions is disillusioning.

Dissatisfaction Expressed — Boswell[1] stated "As a profession we should awaken to the fact that something is wrong with our teaching and practice. When our young graduates enter the practice of what has been taught them, they have great difficulty meeting the conditions attendant upon complete denture prosthesis. Many older men, too, notwithstanding their faithful attendance upon society meetings and refresher courses are in similar experience of disappointment and despair.

"The wrongness must be something other than sheer inability to master this or that technique or teaching presented. Probably some confusion arises because of the great variety and complexity of methods and material offered, but more probably it is that the information given them is incorrect and founded upon wrong concepts."

Numerous Solutions to Problem Causes Confusion—Boucher[2] admitted that "It seems that there are nearly as many ways to solve the problem of jaw relations and occlusions as there are dentists. This has caused confusion in the minds of some to

[1]Boswell, Jesse V.: Practical Occlusion in Relation to Complete Dentures, J. Pros. Dent. 1:308 (May) 1951.

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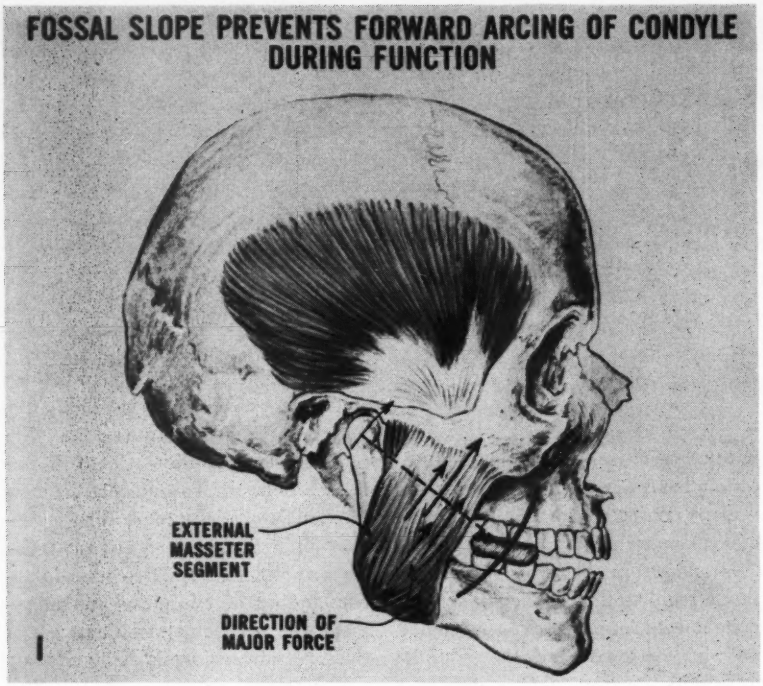


1. ***Masseter, internal pterygoid, and temporalis tend to move the condyle forward—not backward.***

the extent that they know not which way to turn." When even the authorities acknowledge chaos, the next thought suggests that "Where confusion reigns, truth is never present."

Faulty Distinction In Terminology

Confusion is pronounced even in the latest prosthodontic nomenclature. The 1956 edition of the *Glossary of Prosthodontic Terms* violates the first rule of lexicography: the lexicon members have made word changes and have formulated definitions to suit themselves instead of recording established terminology. In its foreword, the Nomenclature Committee states: "The lexicographer has a duty to *lead* as well as to follow." The unhappy results of the committee's subjective leading are apparent in numerous instances, a good example being the committee's decision to delete "articulation" and replace it with "occlusion."

Difference in Meaning— For almost seventy years, the terms "occlude" and "articulate" have had a prominent place in dental nomenclature. Both are necessary to professional terminology but their respective meanings are quite different. In 1887 Bonwill[3] made the distinction clear: "I shall use the term 'articulation' instead of 'occlusion.' Articulation is a word of action throughout, while occlusion answers to the mere act of closing the teeth and lips and keeping them closed; one is active, the other is passive."

Action vs. Inaction—For seven decades, Bonwill's distinction has been recognized and respected by the expert lexicographers who compile the standard lay dictionaries. They have accepted "occlude" as in intransitive verb when used in dentistry. Being an intransitive verb, "occlude" denotes action confined to the teeth alone; Bonwill's "mere act of closing." In contrast, "articulate" is a transitive verb denoting that all jaw and tooth movements are being transmitted from other forces; namely, the articulation of the temporomandibular joints activated by the musculature and restricted by the ligamenture. In short, articulation means *jaw action* to which the occlusals must be shaped to conform; that is, articulated.

Misleading Concept—An example of a misleading statement in jaw physiology is to be found in Granger's[4] concept of functional jaw closure: "As the teeth start through the bolus of food, the temporal, internal pterygoid, and masseter muscles contract to provide the necessary force to overcome the resistance of the bolus. The condyle and meniscus are resting in a lateral protrusive position. The condyle slants back and upward. Force is being applied upward and backward because the muscles are attached to the mandible between the resistance of the bolus of food and the fulcrum of the condyle on this slanting path."

Action of Third Class Lever—It is common knowledge that the jaw is a third class lever. In third class levers, the power application lies, as Granger says, between the load and the fulcrum. When power is applied to a third class lever, however, the fulcrum is always disposed to move along an arc that bends *toward* the load. This trend is shown in Figure 1.

Mechanical Law of Lever—Only the fact that the fossa or fulcrum is immovable while the bolus is not prevents the condyle from moving *forward*, not backward. If it moved backward, it would be the first failure of lever laws in mechanical history. Because the origins of the masseter, internal pterygoid, and much of the temperal muscles lie anterior to their insertion (Fig. 1), it would also be the first time in the history of physiology that an extrinsic muscle pushed instead of pulled the object to which it is attached.

Hinge-axis Concept Attacked

The hinge-axis concept is a primary point of attack by many conventional articulation teachers and clinicians. Lack of training in the

[3]Bonwill, W. G. A., and Litch, W. F.: The American System of Dentistry, Vol. II, p. 486 (1887).

[4]Granger, Ernest R.: Centric Relation, J. Pros. Dent. **2**:167 (March) 1952.

basic sciences lies behind the plausible but groundless arguments against it. The chief contention may be summed up in Kurth's[5] rejection: "I am not interested in hinge-axis centricity as this is just a theory." The theory is sound, nevertheless. Everything that rotates or arcs does so around a point or axal center. This is axiomatic. A condyle rotates; therefore, any argument against its doing so around rotational centers or hinge-axes is an argument against an established truth. If any argument is warranted it should be restricted to the best method of locating hinge-axes.

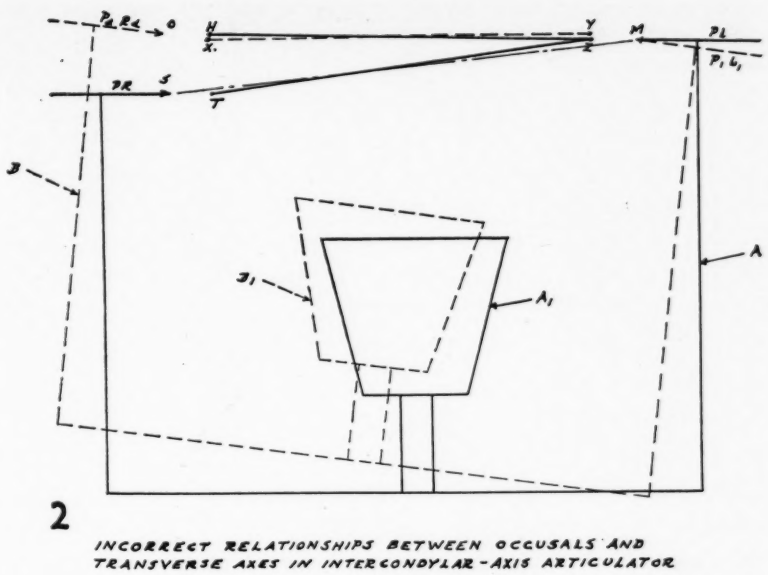
Criticism Expressed — Kurth[6] also states: "Amer shows both the asymmetry of size, shape, and angulation of the left and right condyles . . . He also demonstrates that a line bisecting the two condyles as a hinge-axis would do, would invariably pass through the smallest portion of the condyle. This would be contrary to all ideal engineering principles."

Hinge-axis an Imaginary Line — The criticism quoted has no validity; it does not even relate to the subject. A hinge-axis is not physical entity. It is an imaginary line; a base for measurement only; one around which any given point on a body revolves at a constant and recordable radius. It bears no load so it need not and probably never does "bisect" a condyle. No matter where this rotational center were found to lie in a condyle, it would violate no "ideal engineering principles."

Single Intercondylar Transverse Hinge-axis Impossible — Kurth also shares the erroneous belief that there is a single intercondylar transverse hinge-axis. This is impossible. Transverse hinge-axes, like the vertical and sagittal hinge-axes (certainly, no one would attempt to argue that these last two are intercondylar) can only be *intra*condylar. An intercondylar axis would require a terminal point in each condyle between which such an axis would be suspended.

"Mysterious Center of Rotation"— Granger[7] stated "All of these axes meet at a point within the condyle. This is the mysterious center of rotation. When these points in the two condyles are connected by an imaginary line, it forms the hinge-axis."

Concept Untenable—In a previous statement[8] Granger's rationalization was shown to be untenable because the axes of an irregular body, such as a condyle, never meet; only in perfect spheres do axes have a common point of intersection. The following discussion probes the unfortunate contigencies if such a point *did* exist in each condyle.



2. ***Incorrect relationships between occlusals and transverse axes in intercondylar-axis articulator.***

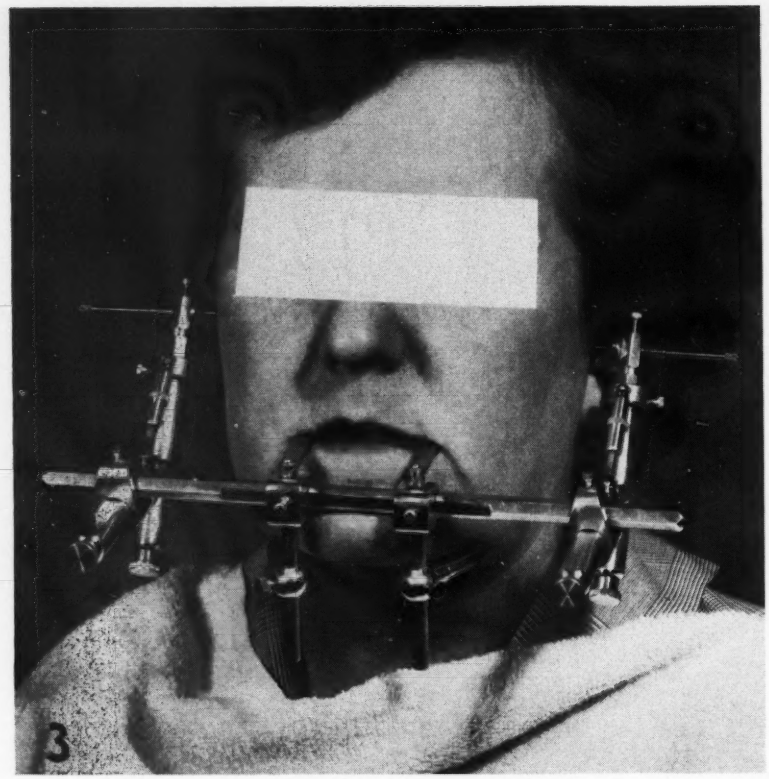
An Imaginary Point—Discussion

It is established that condylar rotational centers are asymmetrically positioned. If they are held to be points, it becomes vital to transfer such points to the articulator with three-dimensional precision. To do this with a one-dimensional recording is impossible. Granted, hinge-axis indicator pins would aim directly at such points during location of the transverse head hinge-axis and would pass through both the dots made on the subject's skin and such condylar points if they existed. But there remains the problem raised by the fallacy of the premises: the unavoidable inaccuracy in transferring these supposed points to the articulator and the shortcomings of the conventional articulator.

Erroneous Premise—Boucher, who also believes in a single intercondylar axis, cannot see that there would be any inaccuracies in making such a hinge-axis transfer to an intercondylar-axis articulator: "An issue is made [by Transographics] of divergent radii and asymmetries in cranial form...if the true opening axis of the mandible is located, the articulator need not be lopsided to reproduce the opening axis thus determined. Instead of the articulator being lopsided, the casts would be mounted lopsided but in the *same* relation to the axis." A one-dimensional sketch shows the error in this observation.

Error in Statement Illustrated—In Figure 2 (1) let the framework marked A represent a hinge bow in position on a subject's head with the hinge indicator pins PL and PR aimed at the assumed center points Z and T of the left and right joints respectively. (2) Let Z and T each be given a horizontal distance of one-half inch from the left and right re-

[5]Kurth, L. E.: Balanced Occlusion, J. Pros. Dent. **4**:164 (March) 1954.
[6]Ibid.: Balanced Occlusion, J. Pros. Dent. **4**:153 (March) 1954.
[7]Granger, Ernest R.: Centric Relation, J. Pros. Dent. **2**:161 (March) 1952.
[8]Page, Harry L.: Transographics and the Transograph, DENTAL DIGEST **62**:162 (April) 1956.



3. ***Typical positional asymmetry of transverse hinge-axes.***

spective hinge-axis dots M and S on the subject's skin. (3) The amount of asymmetry given these supposed center points from the horizontal line HZ is not uncommon between transverse axes, but to save argument, grant that the asymmetry has been exaggerated for clarity. (4) Let A_1 represent the casts attached to the hinge bow on the head, with both ready for transfer to the articulator.

Transference to Articulator—When the transfer has been made, the dotted framework, B, accurately represents the same hinge bow and attached casts mounted on an intercondylar-axis articulator. The articulator hinge-axis studs, with their centering indentations, have been adjusted to contact the nibs of the pins at O and M. Disregarding the discrepant intercondylar distance in the head and on the instrument with its inevitable magnification of error, let the horizontal distance from these indentations to the articulator condyle ball centers also be one-half inch on each side. The casts, being attached to the hinge bow by means of a bite fork, will now take the "lopsided" position B_1, as shown in Figure 2, while the indicator pins take the oblique positions, P_1L_1 and PaRa.

Pins Aim at Off Center Points — When the hinge bow was on the subject's head, the hinge-axes dots on the skin lay on lines continuing from the pin axes to the assumed rotational point centers of the condyles. Now the pins aim at such off-center points in the articulator condyle balls as X and Y.

Enforced Relation to Instrument Axis—To be in the "same relation to the axis," the casts that are "mounted lopsided" should be oriented to an axis running along the dotted line from X to Y. Instead, they are in enforced relation to the horizontal instrument axis represented by the solid line, HZ. Since an axis is invariably perpendicular to the plane of rotation, there is no need to elaborate upon the disastrous results to jaw function when teeth are articulated to this "lopsided" mounting of the casts. Let anyone who doubts this, erect perpendicular bisectors to both axes and note their divergence at the occlusal distance.

Adjustment of Intercondylar-axis—The question now arises as to the result when an intercondylar-axis can be adjusted to the asymmetrical positions of the axis indicator pins. The situation is no better: (1) Just where in the head condyles are the supposed *point* centers to be found? If they existed, the indicator pins would aim directly at them, but these pins offer only a one-dimensional recording; lines that extend into infinity; with no sign telling where on those lines such points are to be found. (2) Transference of the head relationship to the articulator is entirely dependent upon a fixed and arbitrary setting of the instrument's condylar separation. This means that an arbitrary distance must be accepted from each centering indentation on the axis studs to the fixed center of each condyle ball. (3) Disregarding the error between the head and articulator condylar separation, let the distance from the centering indentation of the studs to the condyle ball centers be one-half inch.

Appearance of Discrepancy — The casts represented by A_1 have not been made "lopsided" but the articulator axis has been tipped. For a true cast-axis relationship, the axis should lie along the solid line TZ. Instead, it has moved to the dash-and-dot line SM. The discrepancy, like the discrepancy created by the "lopsided" mounting, may appear to be small but its effect at the occlusals is serious; it contributes materially to the usual endless adjustments and remakes. An erroneous principle is impartial and no amount of "technique" or glib assertions will change it.

No Point to be Located—To refute the single intercondylar hinge-axis completely, it is necessary to discuss one more contingency; that is, whether or not it is possible to locate a single point in a condyle and then reproduce such a point in the articulator with three-dimensional accuracy

by means of an adjustable condylar separation mechanism. The answer is in the negative. It has already been mentioned that the three-dimensional axes of an irregular body never intersect to form such a point; this occurs only in a perfect sphere, so there is no point to be located.

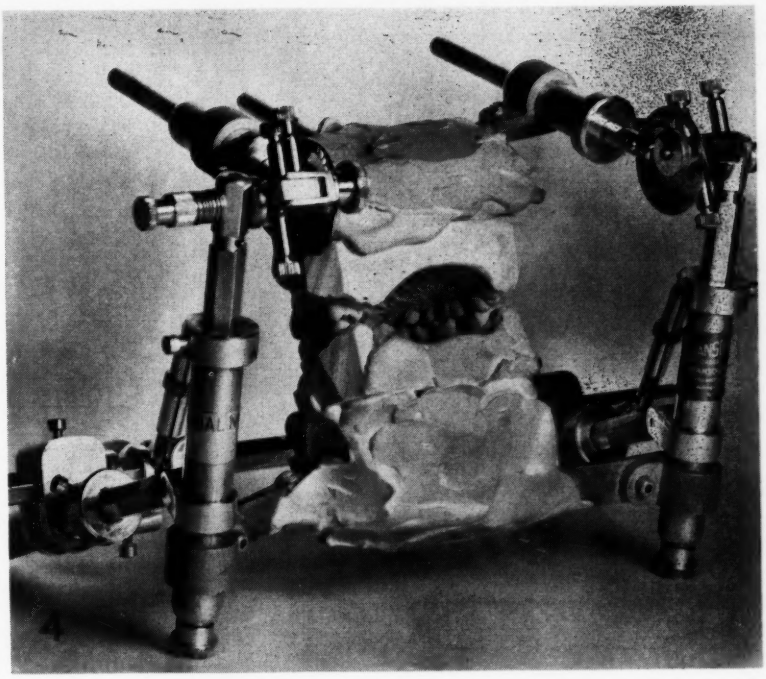
Positional Asymmetry

Kruth's previously quoted statements also disclose an unawareness that an axis is invariably perpendicular to the plane of rotation; a fact, incidentally, that renders worthless all hinge bows using flexible wire hinge indicator pins and those depending upon ball and socket pin adjustments. Although there is always a positional asymmetry between the right and left transverse hinge-axes in every head, they are both perpendicular to the same sagittal plane. Consequently, they are parallel to each other. The same applies to the vertical and sagittal hinge-axes. For this reason, Kurth's "asymmetry in size, shape and angulation" of the condyles has no bearing on the parallelism of the hinge-axes.

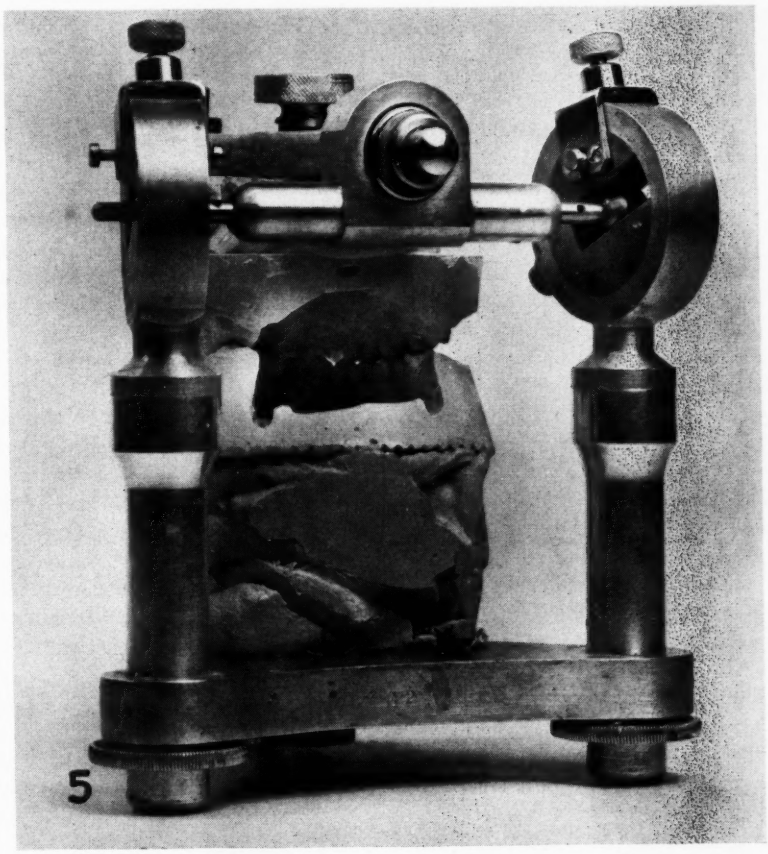
Bennett Movement Created — The positional asymmetry of transverse axes does have an effect upon the closure arcs followed by the occlusals; it creates what is actually the true Bennett movement. Figure 3 shows a positional head asymmetry commonly found between these two axes. Figure 4 shows how asymmetrical *intra*condylar *axal* hinge-axes, when duplicated by pin and sleeve bearings in a slightly flexible instrument, such as the Transograph, have interdentated another subject's teeth perfectly; a condition already known to be true in that subject's head.

Lack of Interdentation Shown — Figure 5 shows the lack of interdentation between the same subject's casts when mounted to the same hinge-axes and interocclusal record and when closed on a conventional rigid *inter*condylar-axis instrument. Similar results will be true in any intercondylar-axis articulator with or without an adjustable intercondylar mechanism.

Mechanical Equivalent of Jaw Shift —in the slightly flexible Transograph,



4. ***Perfect duplication of subject's hinge occlusion by intracondylar-axes instrument.***



5. ***Failure of intercondylar-axis instrument to duplicate the subject's hinge occlusion.***

the asymmetrical pin and sleeve duplicates of the intracondylar transverse head axes have caused the instrument to twist during closure. This is a true mechanical equivalent of the one, two or three-dimensional bodily shift or Bennett movement of the jaw created by the asymmetry of the intracondylar transverse head hinge-axes.

Nonuniform Functional Arc Produces Perfect Closure—When the interocclusal record used to mount the casts in the Transograph was removed, the occlusals in the instrument followed the same *non*uniform functional arc to perfect closure as they followed in the head.

Malocclusion Result of Uniform Nonfunctional Arc — In the conventional instrument, closure followed a *uniform non*functional arc: one lying wholly in one plane perpendicular to the single intercondylar axis. This resulted in serious malocclusion with the lower jaw visibly cocked to the left of its proper destination.

Assertion Challenged — Granger[10] labels the dual axes concept impossible: "Simple geometry shows that a rigid body cannot revolve around two axes simultaneously. In order to have two condylar axes the mandible would have to bend every time it moved." This assertion can be refuted not in terms of geometry, for geometry has no bearing here, but in mechanics and physiology.

Existence of Simultaneous Axes — The automobile engine provides one among many common instances of "a rigid body" revolving "around two axes simultaneously." It is only necessary that the axes be in separate sagittal planes as are main engine bearings and condyles. When the tightly encasing main bearings in an engine are untrue, the engine vibrates; when journals are free, as are the condyles in the temporomandibular joints, they make a compensatory bodily shift.

Condyles Loosely Encapsulated — Within limits, the condyles, being loosely encapsulated, may glide in any direction and, except when held against the ceiling of the fossa by muscles, may even break contact with the fossa. As Granger[11] states, a working condyle has freedom for "moving bodily across the fossa" as it rotates. It would be helpful if he would explain how the condyles are free to move "bodily across the fossa" as they rotate in his concept, but are denied identical freedom in the philosophy of others.

Discussion

No one questions that the condyles are asymmetrically sized, shaped, and positioned. Certainly, no one can question that the condyles are joined at the symphysis and not by any connective mechanism running through the head from condyle to condyle.

Common Structure in Mechanics—The lower jaw is an unitary mechanism with an offset connection; a common structure in mechanics. Since the radius from each condyle's transverse axis to its junction at the symphysis is different, opening or closing jaw movements must create a collateral shift at the joints.

Shift of Mandible in Function — This is not merely a "bodily side shift of the mandible in lateral excursion" as described by Granger[12]; it is a bodily shift of the mandible in vertical *function* with each condyle moving in *any one or in all three dimensions*. Buchman[13] proved a bodily shift in more than one dimension during vertical function while giving an exposition on the Stansbery technique. McIver[14] graphically demonstrated its mechanical equivalent.

Importance Given Bennett Movement — Granger[15] also endows the Bennett movement with extraordinary powers: It ". . . determines the form and position of the sulci and marginal ridges . . ." It ". . . is the power movement as the muscles on the working side contract . . ." It ". . . determines the direction of stress on the supporting structures and therefore whether the cusps are pathologic or physiologic." And, "Of all the mandibular paths, the Bennett movement is by far the most important." If the Bennett movement is responsible for so much even to the health of the alveoli, it would be helpful to know more about it, especially as to its origin.

Cause of Movement Claimed—It is already clear that Granger considers a Bennett movement to be limited to a bodily side-to-side shift of the mandible occurring only during lateral excursions. As for the cause, he states[16] that the ". . . limitation of movement [of the 'balancing' condyle] against the inner curbing of the glenoid fossa determines the Bennett movement."

Explanation of Movement Required—An unsupported statement cannot be accepted as a scientific fact. A condyle, "balancing" or otherwise, does not ride the "inner curbing" or any other part of a fossa under its own power, for it is the mobile part of a universal joint. Yet, no explanation is given to show how a "balancing" condyle can maintain unaided so firm a contact with the bone ceiling and wall *above* and *medial* to it that it forces the working condyle on the *opposite* or *working* side of the head to move outward. In the absence of a valid explanation, what becomes of those manifold powers of the Bennett movement that have been emphasized?

Many Hinge-axes Exist—Far from there being only a single intercondylar hinge-axis, there are, actually, at least twelve hinge-axes in every head; three in each temporomandibular joint and three in each mandibular angle. Only the three in each joint require consideration: (1) the transverse hinge-axes that govern jaw rotation in the sagittal plane (opening and closing); (2) the vertical hinge-axes that govern jaw rotation in the horizontal plane (side-to-side); and (3) the sagittal hinge-axes that govern jaw rotation in the transverse plane (jaw rocking).

(End of Part One)

104 *Garfield Avenue*

[9]Boucher, Carl O.: Editorial, J. Pros. Dent. **5**:295 (May) 1955.

[10]Granger, Ernest R.: Functional Relations of the Stomatognathic System, JADA **48**:643 (June) 1954.

[11]Granger, Ernest R.: Functional Relations of the Stomatognathic System, JADA **48**:644 (June) 1954.

[12]Ibid.: Functional Relations of the Stomatognathic System, JADA **48**:644 (June) 1954.

[13]Buchman, Jack.: Relining Full Upper and Lower Dentures, J. Pros. Dent. **2**:707 (Sept.) 1952.

[14]McIver, Lawrence, W.: Analysis of Jaw Relation in Treated Class II Malocclusion, Angle Orthodontia **24**:49 (January) 1954.

[15]Granger, Ernest R.: Functional Relations of the Stomatognathic System, JADA **48**:644 (June) 1954.

[16]Granger, Ernest R.: Functional Relations of the Stomatognathic System, JADA **48**:643 (June) 1954.

The EDITOR'S *Page*

SINCE the Russians stirred us with their scientific accomplishments we have taken a more critical attitude toward our own scientific activities. This new spirit of evaluation should be projected into the biologic fields as well as into the physical sciences. People who are uncritical and accept the dogmas of scientists on faith and authority alone are now inclined to take a second look at some of the beliefs that they held so strongly. This new spirit of skepticism and inquiry is wholesome.

The biologic implications of the radioactive hazards from natural and man-made sources are being given serious thought by geneticists and physicists. In fact, the trend of apprehension may have gone too far, since we now seem to have been thrown into a state of anxiety over the dangers from the diagnostic use of x-rays.

Although x-rays have been used in clinical practice for fifty years, with an increased application in the last twenty-five years, we have not been aware until recently that the human organism could tolerate only a limited number of roentgen units in a lifetime. Excessive use of x-rays on gonadal tissue leads to genetic mutations. Excessive use of x-rays on any tissue may shorten life expectancy. The precise point at which the harmful and cumulative effects may appear in human beings is unknown. In any case, radiations from cosmic sources, from x-rays, from the fallout from nuclear devices combine to produce an energy that is harmful to man. Because the effects are not immediate or demonstrable we have no way of now measuring exactly how harmful these forces may be.

The eminently responsible World Health Organization has warned: "Generally speaking, the irradiation of living beings may produce radiobiological effects either on the irradiated individual himself, or through him, on his descendants; the former being termed somatic and the latter genetic effects. Somatic effects vary according to the different organs or tissues affected, and range from slight and reversible disturbances such as cutaneous erythema to the induction of leukemia or of other malignant diseases."[1]

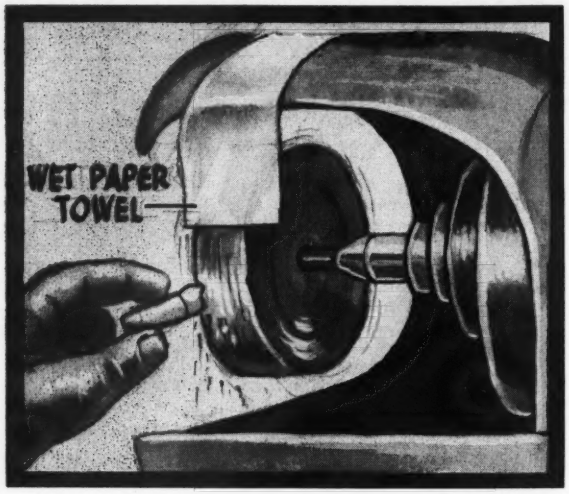
One of the hazardous radioactive agents released from nuclear devices is Strontium^{90}. This artificial radioactive element is released into the atmosphere and above. In time it falls to earth and is combined with the plants that are grown upon the soil. The plants are eaten by animals and, in turn, the meat and milk from these animals become the food for people.

Strontium^{90} has an affinity for calcium and combines with the calcium in bone to produce a salt that has a long life of radioactivity. It is believed that prolonged exposure to the radiation from Strontium^{90} in bone may lead to cancer and leukemia.

Anything that would increase the radioactive life of Strontium^{90} would add to the biologic hazard. It has been postulated that a fluoride salt may unite with Strontium^{90} to make an insoluble compound that will make the excretion of Strontium^{90} more difficult. This theory requires careful and urgent evaluation.

One function of a scientific publication is to present points of view that may be in conflict with prevailing opinion. Neither science nor mankind is served if we turn our eyes from opinions that may be contrary to the ones we hold. The objective of science decrees that we search for facts and for truth even if our cherished views are endangered. With that spirit readers should approach the article POSSIBLE BIOLOGIC HAZARDS OF STRONTIUM^{90} AND OF FLUORIDATION that appears in this issue of this journal.

[1]Responsibilities of the Medical Profession in the Use of X-rays and Other Ionizing Radiation, Statement Prepared by the United Nations Scientific Committee on the Effects of Atomic Radiation, Palais des Nations, Geneva, World Health Organization **2**:261 (August) 1957.



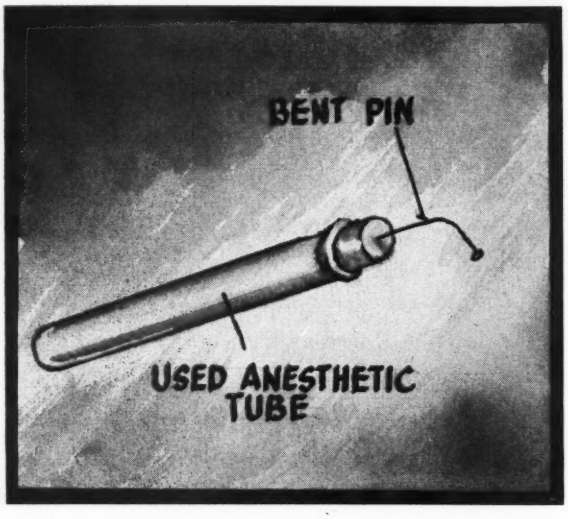
1

Clinical and Laborato

Elimination of Dust and Splash when Trimming Models

Walter C. Harbart, D.D.S., Los Angeles

1. Wet an ordinary paper towel, fold once lengthwise, and lay over the dome of the splash pan so that one end touches the revolving lathe wheel. This creates a gravity wick to keep the wheel and model wet and forms a curtain of protection from splash.

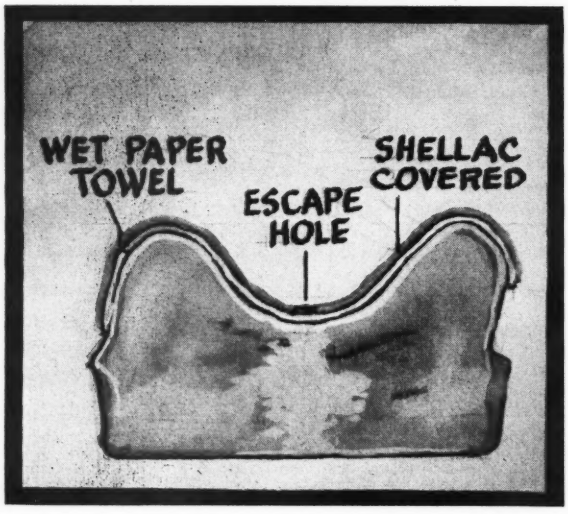


2

An Applicator for Silver Nitrate

K. G. Dunn, L.D.S., R.C.S., Surrey, England

2. Insert a bent pin into the rubber stopper in a used anesthetic tube to make a silver nitrate applicator. From a stock of these applicators a fresh one can be used for each case, thereby avoiding staining and corrosion.



3

Pressure-free Impressions

Martin W. Miller, D.D.S., Chester, Pennsylvania

3. Wet a piece of paper towel and adapt to the cast. Heat the baseplate over the wet towel. The individual baseplate tray will then be large enough to hold the impression paste for adaptation to the tissue without pressure. Drill a hole in the tray to allow for the escape of the excess paste.

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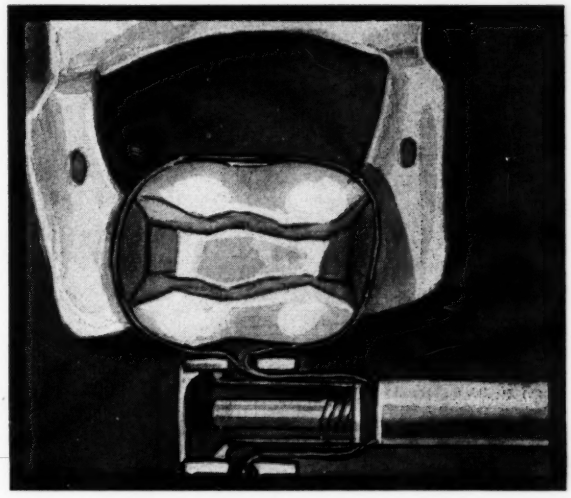
SUGGESTIONS . . .

Matrix Adaptation

Francis Milano, D.D.S., Merchantville, New Jersey

4. A rubber dam clamp applied *mesiodistally* may be used to hold the matrix band on a bell-shaped isolated tooth.



4

Sealing the Amalgam Capsule

S. M. Dooreck, D.D.S., Brooklyn, New York

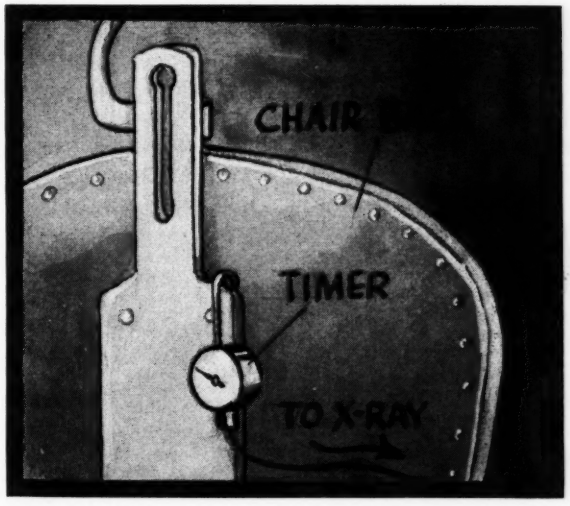
5. The capsule containing the mercury and alloy that is used in a mechanical amalgamator should be sealed with a bead of utility wax to prevent loss of mercury during agitation in the machine.

5

Placement of X-ray Timer

Sanford Paskow, D.D.S., Elizabeth, New Jersey

6. Attach a small hook to one of the screw heads in the back of the operating chair. This will allow the x-ray timer to be in a convenient position during multiple exposures. When the examination is completed the timer is returned to position on the x-ray machine.



6

technique involved; and jot down the advantages of the technique. This shouldn't take ten minutes of your time. Turn to page 84 for a convenient form to use.

Send your ideas to Clinical and Laboratory Suggestions Editor, DENTAL DIGEST, 708 Church Street, Evanston, Illinois.

MEDICINE and the Biologic Sciences

Psittacosis

The incidence of human infection with psittacosis virus is increasing due to the current popularity of parakeets and the relaxation since 1951 of regulations governing the transportation and sale of psittacine birds.

Infection varies from slight involvement simulating common upper respiratory disease to severe and even fatal illness. Infection may be short and terminate abruptly or be prolonged. When psittacosis is suspected, complement fixation of serum samples taken during the acute and convalescent phase should be determined.

In addition to fever, the patient may have myalgia, chills, dyspnea, cough, epistaxis, hemoptysis, chest or abdominal pain, delirium, stupor, nausea, or vomiting. The most characteristic finding by physical examination of the chest is medium moist rales with no consolidation. In some patients, however, the chest is normal or consolidation is found. The degree of pulmonary involvement as shown on roentgenograms ranges from increased bronchovascular markings to widespread infiltration throughout both lungs. Infiltration is usually bronchopneumonic in type.

With severe infection, encephalitic symptoms may be noted. When the disease is fatal, pneumonia is widespread throughout both lungs. Cyanosis often appears early, without labored breathing. Signs of consolidation are extensive, and pleural and pericardial friction rubs may be noticeable. Delirium and stupor occur terminally, and death generally results from pulmonary insufficiency and toxemia.

Differential diagnosis may be difficult if contact with birds cannot be established. Treatment of psittacosis with tetracycline derivatives appears to be effective.

Seibert, Richard H.; Jordan, William S.; and Dingle, John H.: Clinical Variations in the Diagnosis of Psittacosis, New England J. Med. **254**-925-930 (*May*) 1956.

Postoperative Pain

Of the analgesic drugs, morphine provides the greatest relief of postoperative pain with the fewest side reactions. The analgesic potency of codeine does not equal that of morphine, even in large doses. Also codeine is a potent respiratory depressant.

Most patients have some gastrointestinal disturbances after an operation. Parenteral administration is, therefore, preferred to oral. Morphine, particularly, is absorbed poorly from the intestine.

Usually pain is severest during the first twenty-four hours postoperatively. Narcotics are seldom needed after forty-eight hours except for patients who have surgical complications such as infection or who become psychically dependent on the agent.

The dosage of morphine is 10 milligrams per 10 kilograms of body weight. Doses in excess of this do not result in proportional increases in analgesia. In addition, side reactions, such as nausea, vomiting, and respiratory depression, increase significantly with high doses. Intramuscular sodium pentobarbital, 100 milligrams per 70 kilograms of body weight, is a useful adjunct to narcotic administration to allay sleeplessness, restlessness, anxiety, and nausea.

Many of the contributing factors to postoperative pain can be alleviated with good nursing care. Such simple measures as frequent changes of position in bed add to the comfort and help improve the mental state of the patient. Pain after surgery apparently is random with respect to obvious characteristics. No correlation is demonstrable between pain and age or sex of the patient, type or duration of anesthetic, medical or surgical history, personality type, or disorders or preoperative pain.

Keats, Arthur S.: Postoperative Pain: Research and Treatment, J. Chronic Dis. **4**:72-83 (*July*) 1956.

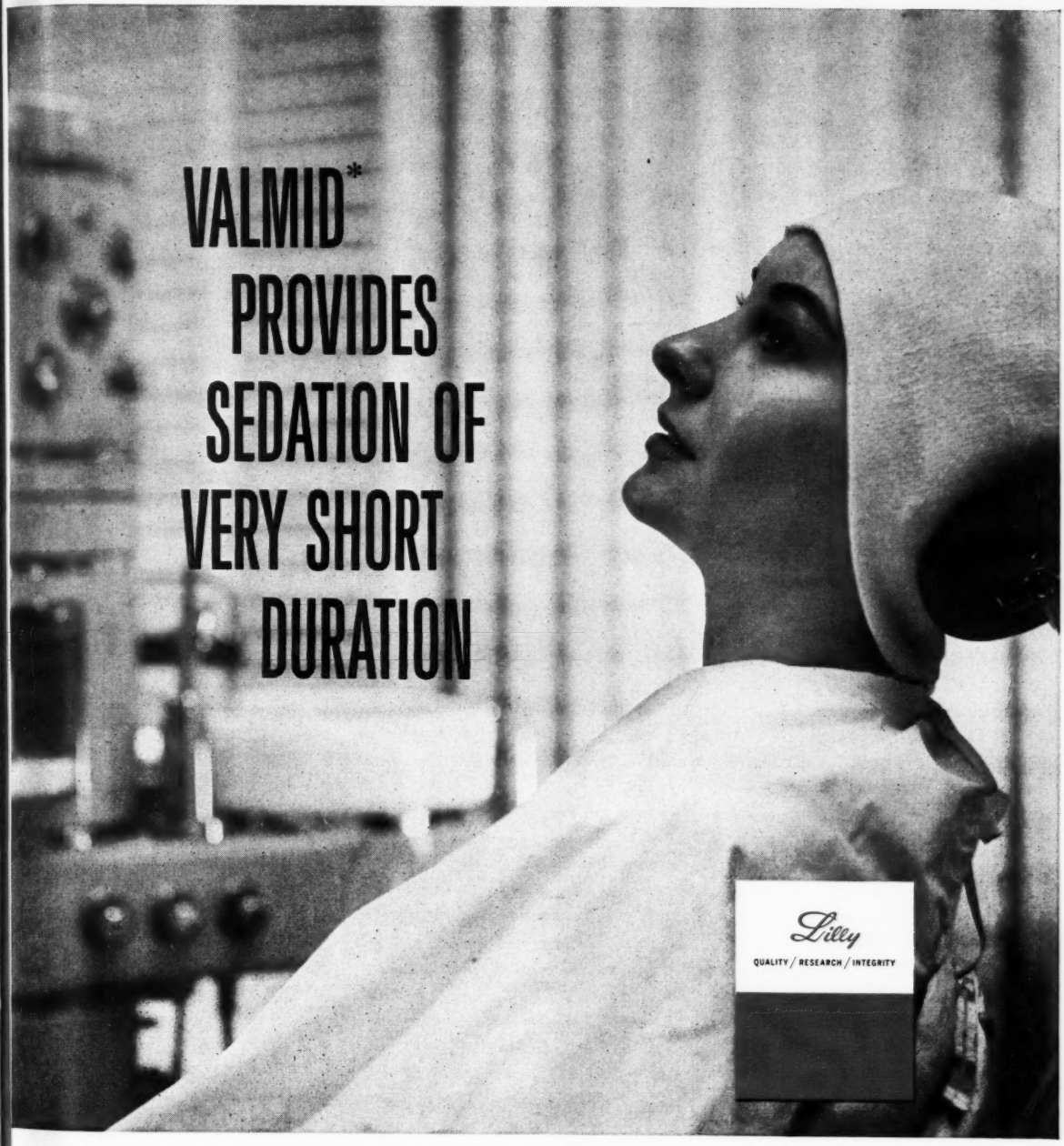
Amebiasis

Apparently healthy persons may harbor Endamoeba histolytica in the intestinal tract without demonstrable harm. The frequency of amebic colitis with hepatic complications is probably much greater than is commonly realized. Amebic ulceration of the large intestine and amebic liver abscesses may occur with no signs, symptoms, or other evidence of amebic infection. Little correlation exists between the number of healthy carriers and the incidence of acute amebic dysentery.

Amebic infection in the large intestine may be extensive without gross evidence of tissue changes. Apparently, chronic illness and debility may break down the balance between host and parasite and allow the protozoan to produce acute amebiasis. Acute dysentery also may occur without apparent reasons from lowered resistance to the parasite.

Although no strain of Endomoeba histolytica is considered nonpathogenic, the small race probably produces only superficial lesions and may account for the asymptomatic cases. Apparently healthy carriers, however, of either race may have slight symp-

(*Continued on page* 82)



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toms and signs if observed for a sufficient length of time.

Ingested amebic cysts release active trophozoites into the cecum, where multiplication occurs in the lumen. Amebas carried toward the terminal colon encyst and are passed in the stools. Under conditions favorable for tissue invasion, motile amebas penetrate the wall of the intestine and produce lesions that may be either extended laterally over a wide area or sharply limited to a small group of glands. Amebic penetration of the bowel wall varies, and may be extremely superficial, restricted to the mucosa only, or through all layers.

Blood and lymph vessels may be entered, resulting in extraintestinal amebic abscesses. Extraintestinal amebiasis is metastatic, primarily from the intestines. The most frequent site is the liver. Superficially located liver abscesses usually extend to the surface. Adhesion to the adjacent viscera or parietal peritoneum is common and results in perforation or direct extension outside the liver.

The next most common site is the lung. The lesions occasionally are embolic in origin but usually result from direct extension of liver abscess through the diaphragm. The abscess may rupture into the pleural of pericardial cavity, but more often the lung becomes adherent to the diaphragm and extension is directly into the lower lobe. When amebas advance into the lung, localized pneumonia occurs and an abscess rapidly forms. The abscess usually opens into a large bronchus and discharges mucoid material containing blood and amebas. When the abscess is directly connected with the liver, contents of the liver abscess are expectorated.

Diagnosis of amebiasis is confirmed by the finding of either cysts or trophozoites of Endamoeba histolytica. Terramycin is the most effective drug for eliminating the parasite from the tissue and from the lumen of the large intestine. Long-term observation is essential in the treatment of amebiasis since relapse is common regardless of the drug used.

Frye, William W.: The Panthogenesis and Therapy of Human Amebiasis, Am. J. Gastroenterol. **25**:315-332 (*May*) 1956.

Intramedullary Hip Prosthesis

Intramedullary hip replacements should be used mainly to salvage fractured femoral necks if other treatment fails to unite the fragments or if aseptic necrosis occurs after union. A prosthesis may occasionally be necessary immediately after fracture because of technical surgical difficulties or special circumstances.

With fracture high on the femoral neck, the live neck will ultimately unite even with a dead head. The head becomes revascularized and within nine months is viable. Even if the neck is partly absorbed in telescopic healing, the hip is perfectly stable and causes no pain or limp.

Displaced fractures fail to unite after nailing in about 20 per cent of cases. Aseptic necrosis occurs after union in another 22 per cent. Half of the patients with aseptic necrosis, however, have no pain. Results of nailing, therefore, can be termed good in roughly two-thirds of cases.

The aged may or may not require use of endoprothesis. Nailing may be unwise because of lengthy convalescence and high cost. Generally, it produces less morbidity than a replacement procedure. Even in the tenth decade of life, femoral necks have mended so that walking can be done without a cane as well as or better than with prompt substitution.

There are some technical difficulties at operation which may necessitate artificial replacement:

(1) Inadequate reduction of the head on the neck does not preclude satisfactory junction. Nailing should, therefore, be attempted and a prosthesis may be inserted as a secondary procedure if necessary. Open reduction is rarely more successful than closed procedures.

(2) End-to-side nailing which results if obesity prevents clear roentgen visualization of the femoral head at operation, invariably causes aseptic necrosis and necessitates a prosthesis.

(3) Split head fragment, a weight-bearing portion of the head torn loose by nailing, requires a prosthesis without delay. Decalcified bone of a soft head offers no support for a nail.

Immediate insertion of the substitute head is required in the following circumstances:

(1) Fracture of the femoral neck from aseptic necrosis of the head is associated with death of bone well down in the neck. Aseptic necrosis in young people is often due to caisson disease or dislocated hip. The socket is seldom altered and rarely has to be reamed out to fit the metal head. In older persons with necrosis after healing, the femoral head and acetabulum are often irregular and require reaming, a formidable process in the aged.

(2) Radium necrosis fracture of the femoral neck after treatment of cervical cancer is unlikely to heal and warrants immediate insertion of an endoprosthesis.

(3) Chronic multiple rheumatoid arthritis justifies early use of a prosthesis for an associated fracture of the femoral neck.

(4) Permanently bedridden patients are in less danger from nailing than from primary use of an artificial femoral head.

(5) For a person with a metastatic tumor, a prosthesis may be used for hip fracture if a short life span is anticipated.

(6) Mental disease may necessitate a substitute for a fractured femoral head if shock treatments are being given, as nailing might interrupt shock therapy for nine months.

Thompson, Frederick R.: Indications and Contraindications for the Early Use of an Intramedullary Hip Prosthesis, Clin. Orthopaed., No. 6, Pages 9-16, 1956.

Poliomyelitis—Pathogenesis

Invasion of the central nervous system by poliomyelitis virus from extraneural sites probably takes place through the peripheral ganglia rather than directly across blood vessels. Antibody acts mainly on the extraneural sites of multiplication and, therefore, may either prevent or reduce the amount of virus that does spread.

(*Continued on page* 84)

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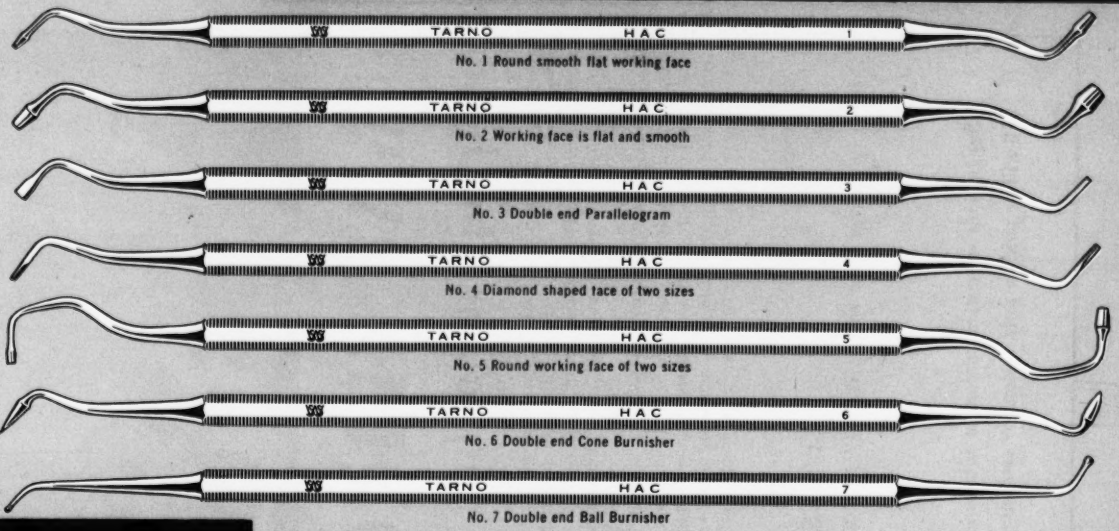

No. 1 Round smooth flat working face

No. 2 Working face is flat and smooth

No. 3 Double end Parallelogram

No. 4 Diamond shaped face of two sizes

No. 5 Round working face of two sizes

No. 6 Double end Cone Burnisher

No. 7 Double end Ball Burnisher

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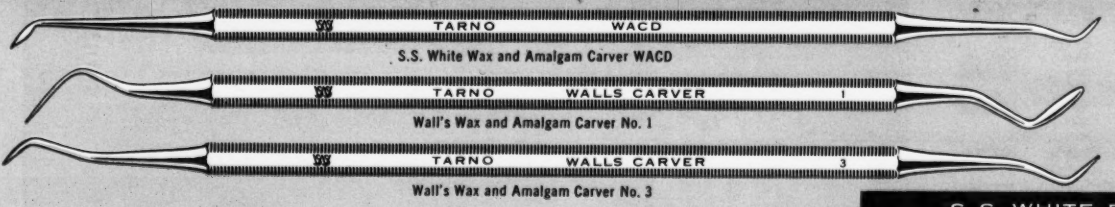

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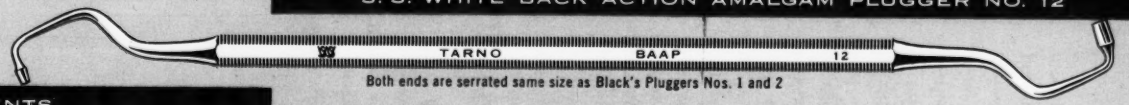
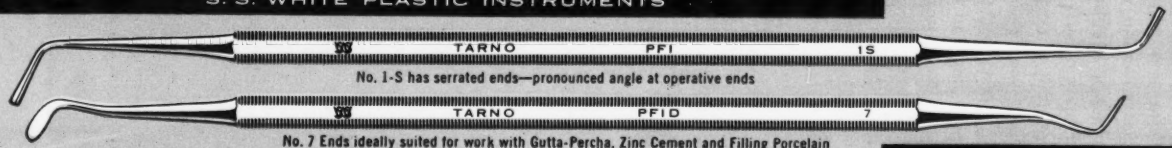


Both ends are serrated same size as Black's Pluggers Nos. 1 and 2

S. S. WHITE PLASTIC INSTRUMENTS



No. 1-S has serrated ends—pronounced angle at operative ends

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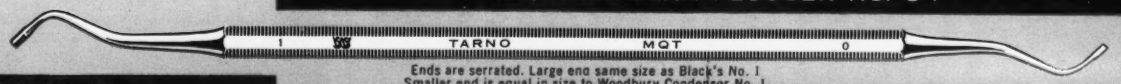

Ends are serrated. Large end same size as Black's No. 1
Smaller end is equal in size to Woodbury Condenser No. 1

MORTONSON PLASTIC INSTRUMENT NO. 2

TARNO S.S.WHITE

CLINICAL AND LABORATORY SUGGESTIONS

(*See pages* 78 *and* 79)

Form to be Used by Contributors

To: Clinical and Laboratory Suggestions Editor

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Evanston, Illinois

From: _____

_____

Subject: _____

Explanation of Procedure:

Sketch:

Suggestions submitted cannot be acknowledged or returned.

$10 will be paid on publication for each suggestion that is used.

The ingested virus first attacks the superficial epithelium of the oropharynx and the lower alimentary tract. Growth continues until host resistance develops to halt extension from cell to cell.

The intestine is the most important site of multiplication in man. Propagation occurs in the oropharynx only after large amounts of virus are swallowed. The virus disappears from the throat early in the course of the infectious process.

Virus in the stool is derived mainly from the cells of the lower alimentary mucosa. The amount of virus per gram of stool is about the same whether or not virus is recovered from the throat.

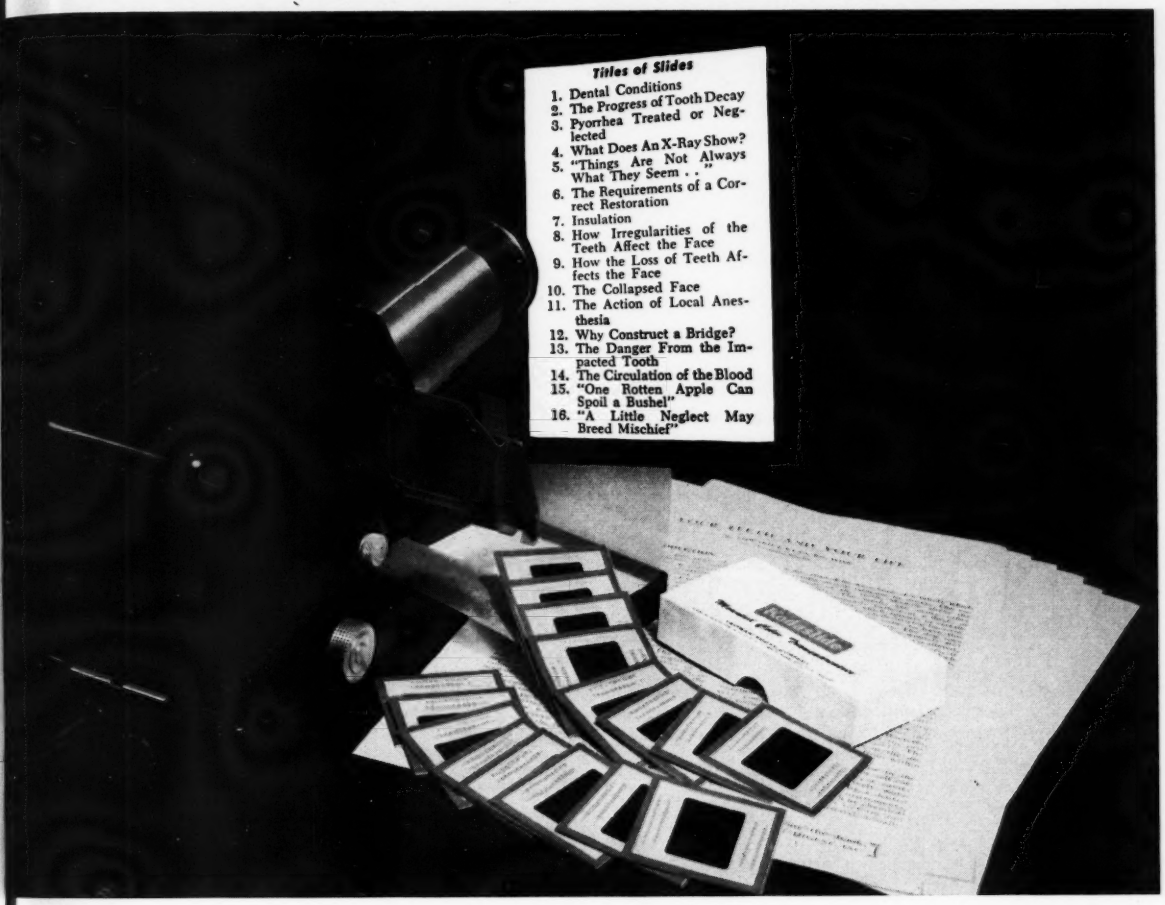
The capacity to damage neurons and the ability to multiply in the digestive tract are independent properties of polio virus. A strongly neurotropic virus, may, therefore, fail to produce infection. Hosts are variable in susceptibility of alimentary tracts and neurons to virus invasion.

From the epithelium, the virus is absorbed into the regional lymph nodes. Attenuated strains do not multiply in lymph nodes. Virus injected intramuscularly does not produce antibody or other evidence of infection and elaboration of large amount of virus continues in the alimentary tract long after a high antibody titer prevents lymph node infection.

When the amount of virus in the lymph nodes exceeds the absorptive ability of the cells, viremia results. If multiplication occurs only in the alimentary tract, the spill-over is undemonstrable or detectable only for a few days by recovery of virus in the spleen. High levels of viremia occur only when a strain can multiply in lymph nodes, fat and muscle, as well as in the digestive tract.

Virus in the blood is quickly removed by reticuloendothelial cells and other tissues. Extraneural tissues become infected by this route with certain strains of polio virus. Virus in the blood can also localize in the alimentary mucosa. The high incidence of oropharyngeal infection in poliomyelitis may be due to this mechanism rather than to an initial

(*Continued on page* 86)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5. "Things Are Not Always What They Seem . . ."
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8. How Irregularities of the Teeth Affect the Face
9. How the Loss of Teeth Affects the Face
10. The Collapsed Face
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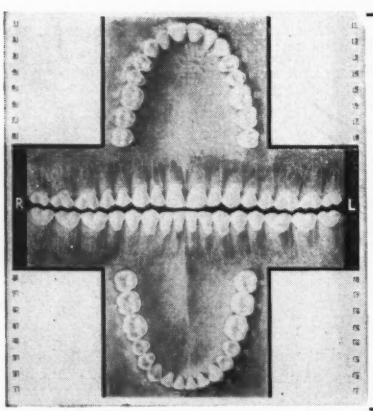

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ingestion of large doses of the virus.

Antibody acts mainly on the sites of extraneural multiplication. Large amounts of antibody might fail to prevent initial growth in the intestine, yet any quantity could interfere with invasion of nerves or prevent spread of virus to other organs. Antibody can either completely prevent invasion of the central nervous system or reduce the amount of virus that does invade, thereby increasing the proportion of nonparalytic and slight infections of the central nervous system.

Sabin, Albert B.: Pathogenesis of Poliomyelitis, Science **123**:1151-1157 (*July*) 1956.

Sinuses, Infection, and Nutrition

W. D. CURRIER, M.D.

Nutritional Deficiencies

It is well known that nutritional deficiencies will produce mucous membrane disease. Although most of these ravages are recognized chiefly in the mouth mucosal tissues, other such membranes are involved throughout the body.

Similar Membrane Involved— The same blood and body fluids nourish all mucosal structures. There is no line of demarcation between mucosal surfaces. Body fluids which adversely affect one will also harm the others, although the disease manifestations may be more easily recognized in one than in another.

Source of Repair Material— Fundamentally the source of any body building material is in the chemicals supplied. These come solely from the food taken into the mouth. It is true that certain nutritional elements, as well as most endocrine, mucous, and other secretions are synthesized in the body. But their synthesis depends upon a proper supply of biochemicals from food. Man, therefore, is what he eats. It is estimated that 90 per cent of all tissue cells and fluids will be rebuilt within a year. Rebuilt with what?

Adapted from *Modern Nutrition* **9**:20 (March) 1956.

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for moderate
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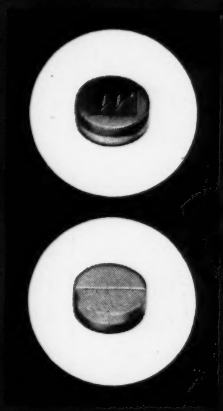

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* U. S. PATENT NO. 2,441,498 *

Contra-Angles

Peanut Butter and Candlelight

Most of us dentists are so preoccupied with the mechanics of the masticatory apparatus that we forget some of the subtle overtones that are involved in eating. The chewing of food is certainly the first step in the digestive process and the maintenance of the mechanics of chewing is a large part of the dentist's work. The sight, smell, taste, and touch of food are also important in the enjoyment of eating. In addition to the actual sensory experiences that are part of eating there are collateral values that add to or subtract from the satisfaction of taking food.

The two most important of these values are probably companionship and the surroundings. Amiable company and a pleasant atmosphere are important aids to digestion. Shrill or sour company will disturb the gastric secretions in all except the most insensitive person. Glaring lights, undue noise, agitation in the surroundings are not conducive to pleasure in eating. It is no mere accident that *companion* is derived from *com* (together) and *panis* (bread).

Some people, the linear body types of Sheldon (ectomorphs), are more highly developed in their nervous systems than are the jolly fat men (endomorphs) or the men of bone and muscle (mesomorphs). We would expect the ectomorphs to be more conscious of and sensitive to their surroundings than are the other two basic body types.

Because the ectomorph is built with a more highly organized nervous system we would expect him to have a temperament that would make him more reactive. This he has. The endomorph was intended for visceral ac-

(*Continued on page* 90)

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BS POLISHERS

Slightly Controversial

Sometimes we feel we know a certain thing, yet actual proof eludes our grasp. We know it cannot be otherwise, yet how to convince others for their own good is a hard thing.

For instance, the dental cement in common use has no real qualities that recommend it for dental use, except the fact that there was nothing else to use for almost fifty years. *Dental cement is soluble in the mouth fluids and is non-adhesive.*

Here is research we know there is something better available. But how to convince you? Here is a cement that is *INSOLUBLE in mouth fluids, and has 6,000 psi adhesive strength . . . wet! Furthermore, it is kinder to the pulp than ordinary cement liquid.* And to clinch the argument it is caries resistant.

What more does a dentist need to convince him to change? Perhaps this. . . . Sometime ago. *I* had two upper centrals prepared for jackets. Not much was left for a conventional preparation. The two restorations were cemented on with ordinary dental cement. I did not want them to come off, but here is an actual letter sent to my dentist.

Dear . . .:

As you know, a few months ago I came to you for some dental work. First we tackled my two front upper teeth. You made me two very beautiful GAC's (gold acrylic jackets) and I was very, very pleased. They were cemented on with regular dental cement.

Then, . . ., two days later the left one came off. We recemented it here with FluorOn. A short time later the right one came uncemented, and that was also recemented with FluorOn. At the present date they are still on.

For all of this I am not blaming you. You know that I think you are tops, and as a matter of fact you are. But I do believe you are like thousands of other dentists who are too busy to make a change; too busy to really go into the problem of cementation. *Regular dental cement is soluble in the fluids of the mouth and has absolutely no adhesion.* It also has many other defects too numerous to go into. *FluorOn is insoluble in the fluids of the mouth and is tremendously adhesive.* On the face of it, I see no comparison.

. . ., you did not have much left of my teeth to prepare. I can easily understand why dental cement did not hold. So why not look into this question of cements more thoroughly? I'll be glad to give you a demonstration.

Fred

This, to me is actual proof. There is no use in hanging on to old fashioned materials just because they have been used for fifty years. Why not prove this for yourself?

We will send you a generous sample for $1.00.

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MIRACLE 50
acrylic denture

STRENGTH 3. If you want all of the above . . . PLUS strength . . . absolute freedom from breakage . . . then specify

MYSTIC 100
acrylic denture

PROOF 4. MIRACLE and MYSTIC are guaranteed to accurately fit any stone model or metal die upon which they are processed.

MYSTIC is guaranteed to withstand intact any conceivable dental accident.

INTRODUCTORY OFFER

1. Send $1.00 for one unit of Miracle or $1.50 for one unit of Mystic.
2. Have your dental lab use it on your next case.
3. Check your results against any other denture acrylic.

"Complete accuracy makes a whale of a difference."

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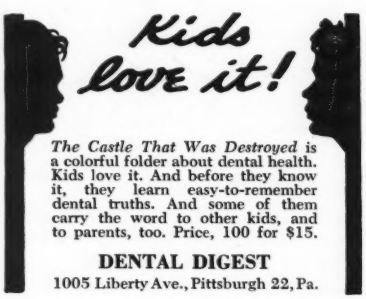

The Castle That Was Destroyed is a colorful folder about dental health. Kids love it. And before they know it, they learn easy-to-remember dental truths. And some of them carry the word to other kids, and to parents, too. Price, 100 for $15.

DENTAL DIGEST
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tivity and so long as his gastric pouch is filled he is not too concerned with the people or the place that may be associated with the filling process. The mesomorph is structured for a life of action and for the expenditure of energy. So long as he has enough fuel to stoke his metabolic boilers he is quite satisfied and indifferent to people and places.

This writing on some of the subtleties of eating was prompted by two recent experiences that I had.

A dear and loyal endomorphic friend called me to ask the name and address of an exotic restaurant that we were in more than 15 years ago. He remembered the food with ensalivating fondness. He is familiar with and extremely interested in Sheldon's body types. My friend knows that I am predominately ectomorphic so he expected me to remember the extraneous facts: the name and address of the restaurant. Although I recall nothing about the food, I did remember the street and the name of the restaurant.

The other incident involved an ectomorph. This one said that he would rather "eat a peanut butter sandwich in the candlelight than the most delectable dish in a traumatic atmosphere." This may be carrying the esthetic touch too far, but the point is plain: people do *not* react in similar fashion to the same stimulus. The degree and kind of sensory stimulation differ among people because of differences in the structure and physiology of their nervous systems. The reactions that follow stimuli are even more varied. What is "one man's meat is another's poison" is more than a matter of toxicity or allergy. The entire nervous system, the total personality, may participate in the physiologic process of eating. The surroundings or the human relations in eating may be "toxic" or salutary. We should, therefore, always make the effort to choose congenial companions and pleasing environment when we *companis*.

The ulcer-prone people who are found in some special occupations represent a combination of ectomorphs who are forced to carry on

business discussions over the table with people that they do not like under conditions and in places that are jarring on their nervous systems. The entire galaxy of other psychosomatic diseases have other elusive components that do not always meet the eye when we make a clinical evaluation.

A College that Trains More Than the Mind

Hospitals, hotels, and colleges usually have dieticians on their payrolls. A dietician is not the same as a nutritionist. The dietician is concerned with the amount and kind of food that goes *into the mouth;* the nutritionist is concerned with the nutrient material that reaches *every cell of the body.*

The dismal meals that are served in most hospitals are an affront to the tastebuds and some of the other sensory receptions of the body: smell, sight, touch. If one is prepared to pay $10 to $15 a day (with the tip extra) for his meals he can be well nourished under favorable surroundings in the large hotels. The plight of the college student is grave. He usually does not have the money to buy good meals nor the knowledge to select proper ones. Sweet rolls and coffee; hamburgers and french fried potatoes, and malted milk are not enough to sustain the young man or woman in optimum health. Nor do the cigarettes, candy bars, and soft drinks add to their nutritional stature.

One college in the United States has done something about the situation: Fairleigh Dickinson University of Rutherford, New Jersey. The President of the University, Doctor Peter Sammartino, has made this announcement of a far-reaching nutrition program for students:

"Regarding the food service, the University wishes to make it very clear that boarding students will be required to follow a unique nutritional regime. In affiliation with the American Academy of Nutrition, Fairleigh Dickinson University will have the guidance of nationally known experts: Doctor William Coda Martin, Doctor William E. Smith, Doctor Ehrenfried E. Pfeiffer, Doctor Edward J. Ryan, and Doctor Francis M. Pottenger, Jr. It is the aim of the University to have the healthiest group of boarding students anywhere. No effort or expense will be spared to make this possible. Organically grown foods, free of poison sprays, will be purchased wherever and whenever possible. A sheet listing sample menus will be available to prospective students. The only factor which is unpredictable is that of kitchen help which often is difficult to find or train. The following points may be mentioned:

"1. Students will be required to eat a complete breakfast every morning consisting of fruit, eggs or other proteins, whole wheat bread, and milk. This is intended to give the necessary proteins to keep up the proper level of blood sugar throughout the morning and avoid midmorning fatigue. Coffee, although of no nutritional value, will be available.

"2. Walker-Gordon certified milk will be used.

(*Continued on page* 92)

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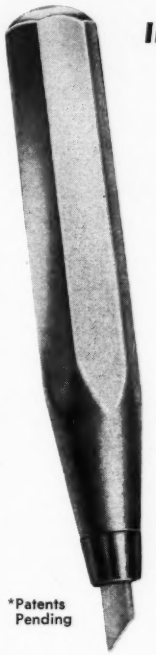

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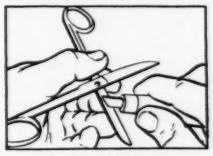

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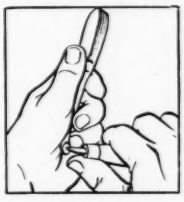

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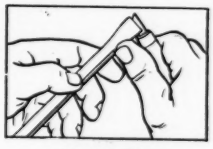

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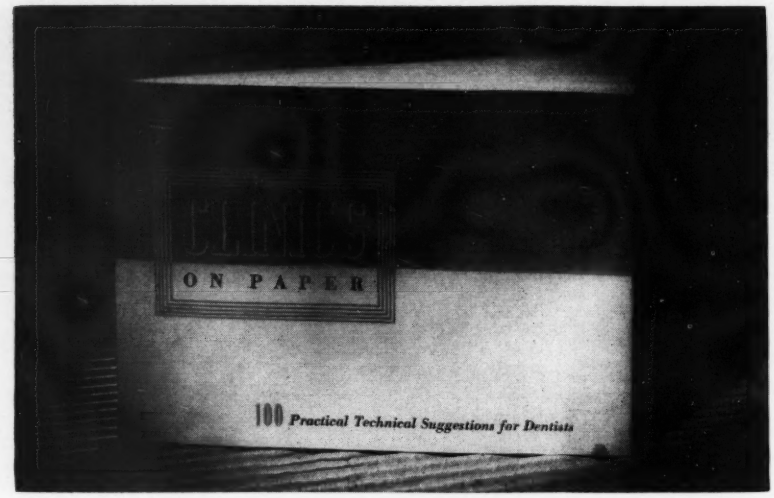

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Volume 4 of *Clinics On Paper* was welcome news to many of the 5000 dentists who had purchased each of the three previous volumes. Since its introduction only a few months ago hundreds have purchased Volume 4 to complete their file of this valuable material. *None of its 100 suggestions appeared in the preceding volumes.*

Like each of the three preceding volumes, Volume 4 is printed in two colors on fine paper, *and is indexed by subjects for easier reference.*

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Radiation: Further Warnings

Under the auspices of the United States Atomic Energy Commission, a committee of twelve scientists (including Doctor Willard Libby) have reconsidered the hazards from fallout of Strontium 90. They believe that fallout is not uniform over the globe but tends to band in the temperate zone of the northern hemisphere where the jet streams flow just below the stratosphere; thus, it is heavy in the northern United States. The committee predict that the Strontium 90 so far generated will cause skeletal concentrations of 2 to 5 Strontium units in the northeastern states if present conditions are maintained, and 4 to 10 units if the predicted "banding" takes place. The corresponding figures if tests continue at the same rate in "the next several years" will be 5 to 12 and 10 to 25 units. (From the calculations of the Atomic Scientists' Association, 10 units might be expected to produce bone sarcoma in about 1 in 20,000 of those affected.)

From Annotations, *Lancet* 2:1325 (Dec. 28) 1957.

"3. While no guarantee can be given, the University is planning to make its own whole wheat bread from freshly ground, organically grown wheat, delivered fresh every week.

"4. There will be a minimum of fats and greases used. Vegetable oils of the highest nutritional value and the lowest toxic count will be used.

"5. Fresh fruits, vegetables, and cheese will be used as much as possible. Fresh salads will be served daily.

"6. There will be a minimum of sugar and refined flour used. While some cake and ice cream will be served, most of these will be made by special recipes, using little or no sugar, and whole wheat whenever possible.

"7. The three miracle foods, extremely high in B vitamins and iron, will be available always: wheat germ, brewers' yeast, and liver, at no extra cost to students.

"8. Typical evening entrees are: roast beef, hamburger, steak, lamb chops, chicken and fish. The emphasis will be on broiled foods.

"We are confident that students thus guided into good nutritional habits will enjoy good health and have a minimum of ailments and discomforts. The cooperation of your physician is invited and encouraged."

We are currently in a dither over our educational system. The demand for more workers in the health fields has been supplanted by the urgent cry for more scientists and engineers. But nobody, so far as I know, has said a word about the health conditions under which these students are to live while they receive their important and costly training. It is refreshing to see that one educator and university president, Peter Sammartino, understands that education is something more than cramming young heads full of facts and figures. The lessons that will be learned in proper nutrition by the students of Fairleigh Dickinson University will be carried into later life and will improve the generations. That is *total* education.

Do you wish that you had this unusual opportunity to learn the facts of nutritional life when *you* were young? I certainly do! —E. J. R.